Typical Filtering Application

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Filtering out

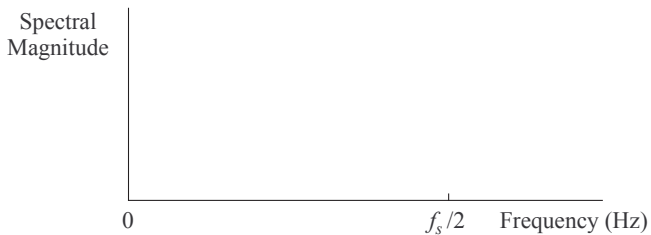# Typical Filtering Application

Filtering out noise

Typical Filtering Application

Filtering out noise from samples of an audio signal.

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0                                    Frequency (Hz)
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Typical Filtering Application

Filtering out noise from samples of an audio signal.

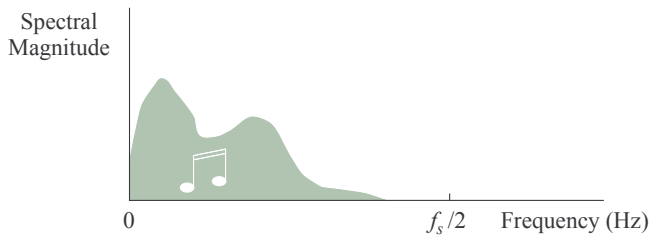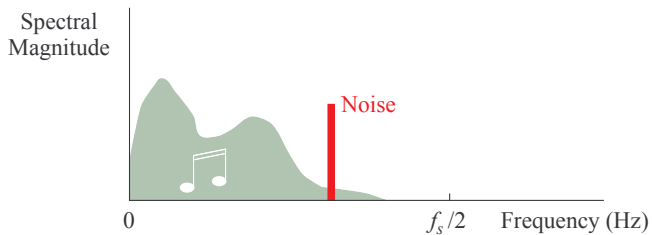$$0 \qquad\qquad\qquad f_s/2 \qquad \text{Frequency (Hz)}$$

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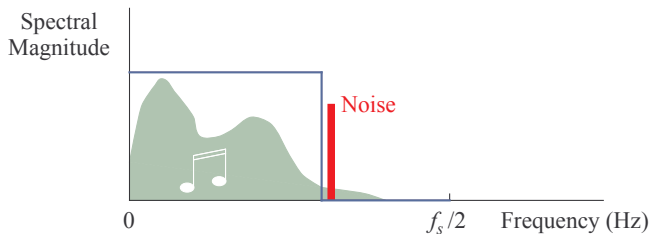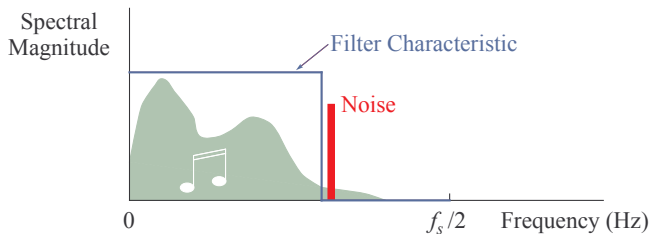
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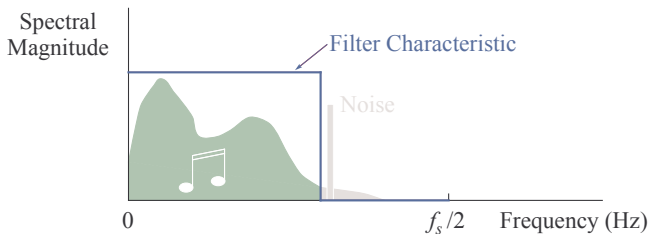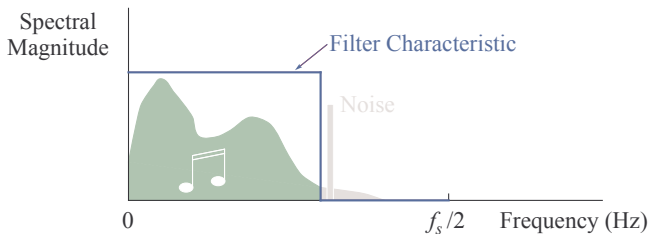Filtering out noise from samples of an audio signal.

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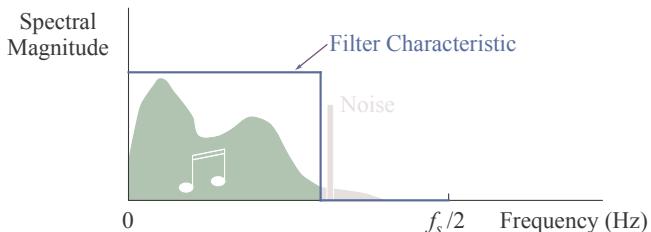# Typical Filtering Application

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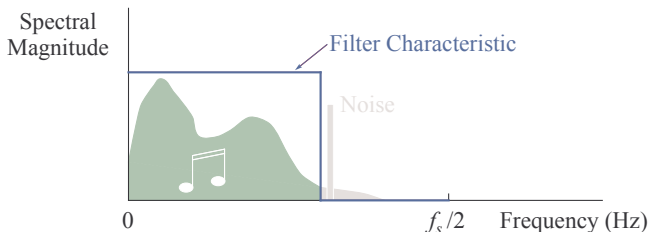
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Typical Filtering Application

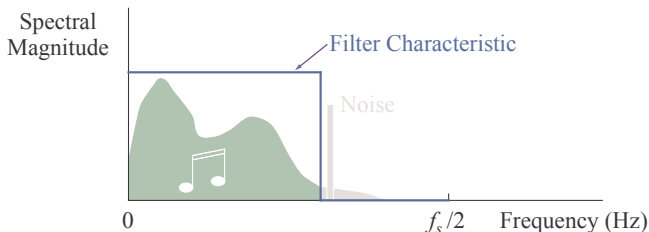Filtering out noise from samples of an audio signal.

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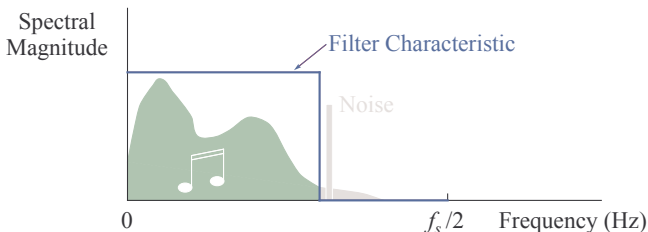

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Typical Filtering Application

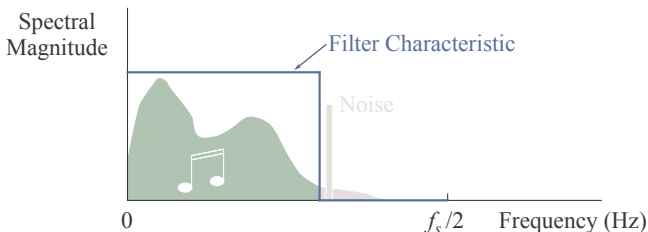Filtering out noise from samples of an audio signal.

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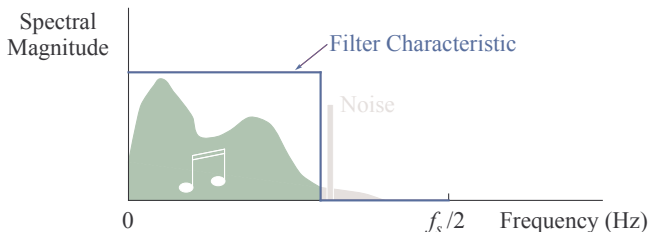Filtering out noise from samples of an audio signal.

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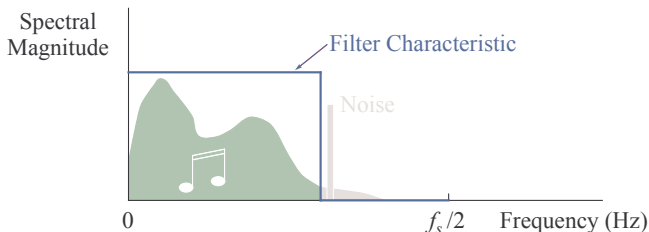Filtering out noise from samples of an audio signal.

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Challenge:

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Filtering out noise from samples of an audio signal.

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Challenge: Design a filter with the desired characteristic.

Typical Filtering Application

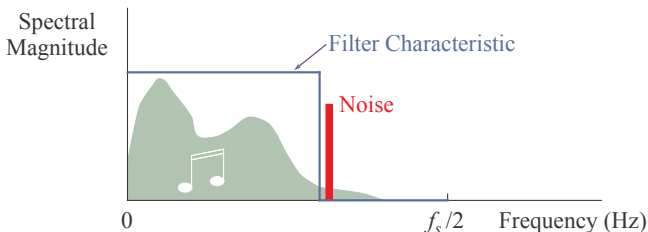Filtering out noise from samples of an audio signal.

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Challenge: Design a filter with the desired characteristic.

Introductory Example

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Filter

Introductory Example

Filter acts on the input sequence

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$

Introductory Example

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$$y[n] \;=$$

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$$y[n] \;=\; x[n]$$

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$$y[n] \;=\; x[n] \;+\; 2x[n-1]$$

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$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2]$$

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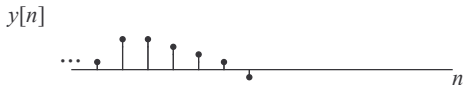
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Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
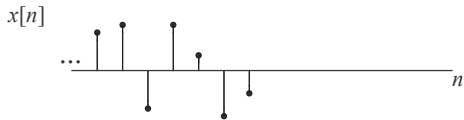
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n

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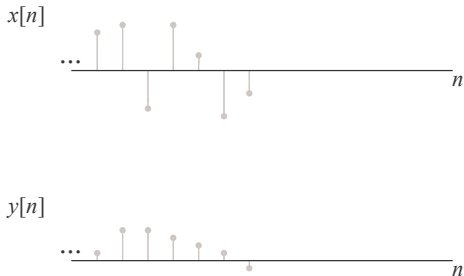
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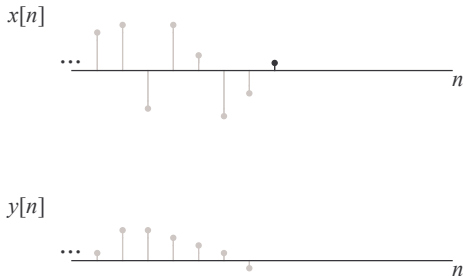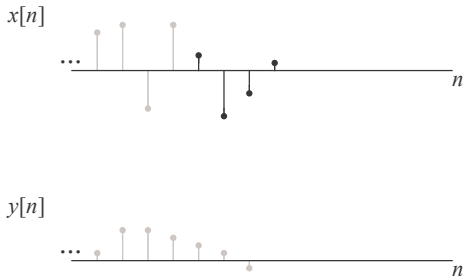$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

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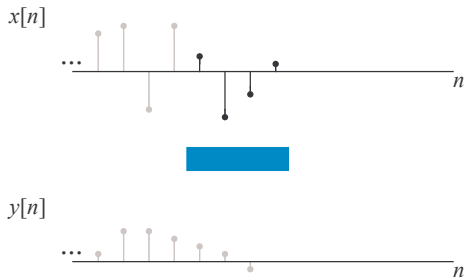
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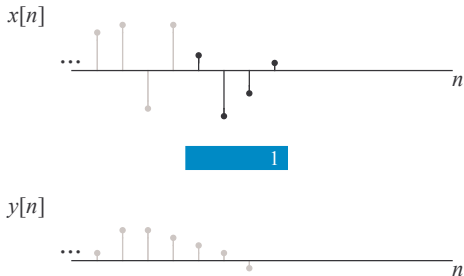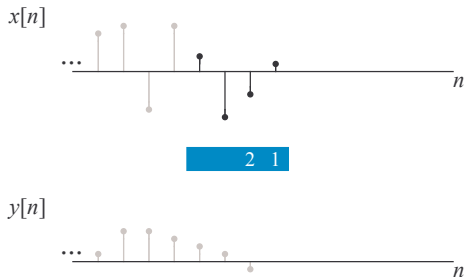
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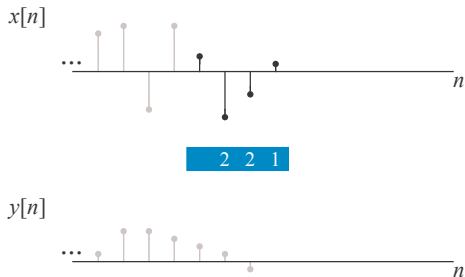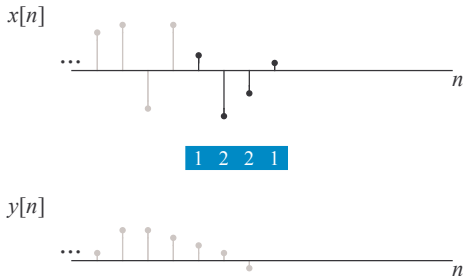$$y[n] = x[n] + 2x[n-1] + 2x[n-2] + x[n-3]$$

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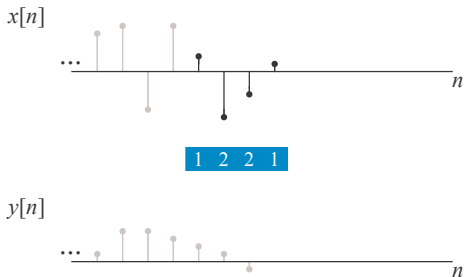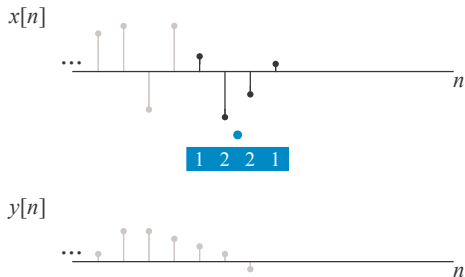$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

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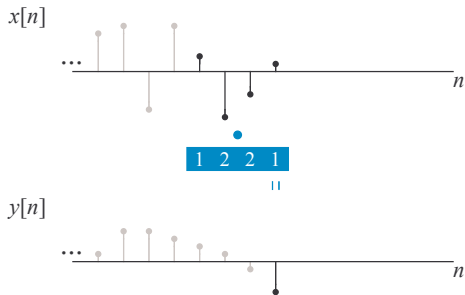
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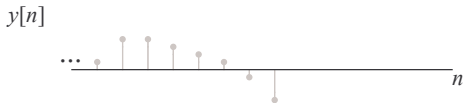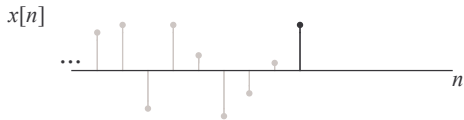
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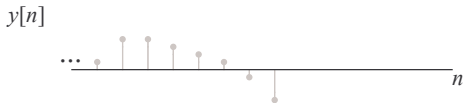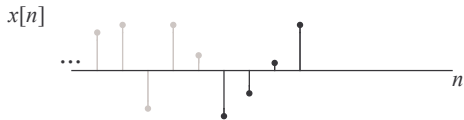
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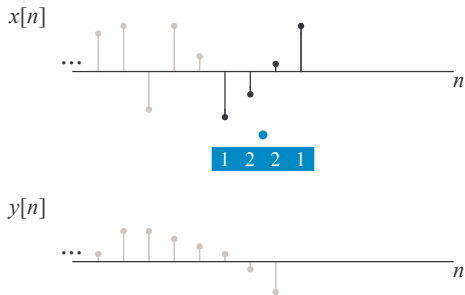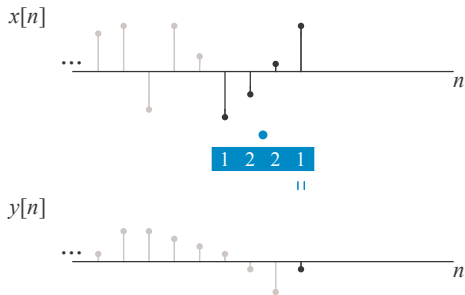$$y[n] = x[n] + 2x[n-1] + 2x[n-2] + x[n-3]$$

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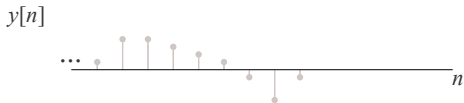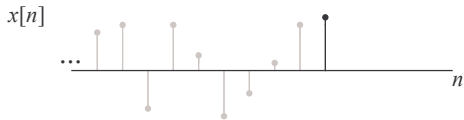
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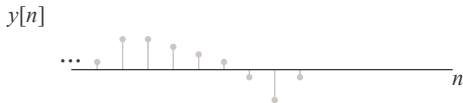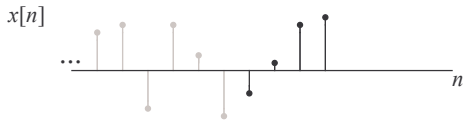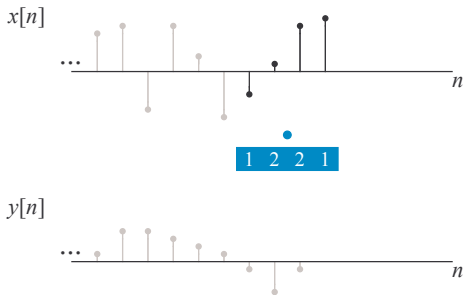$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

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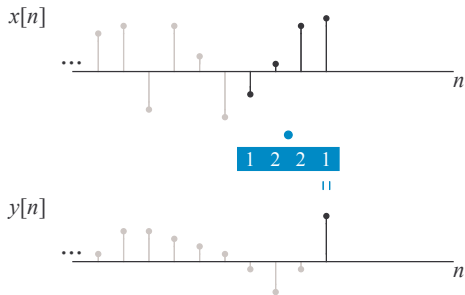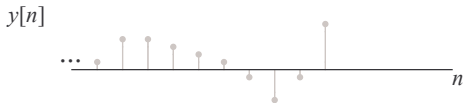$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

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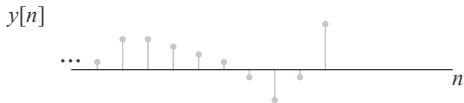
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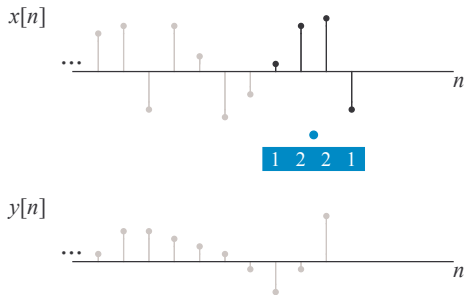
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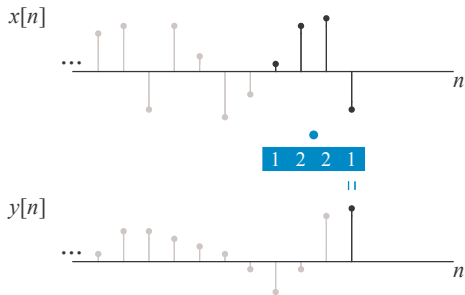
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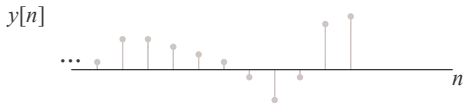
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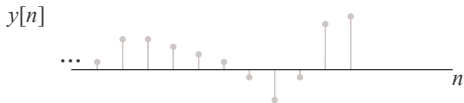
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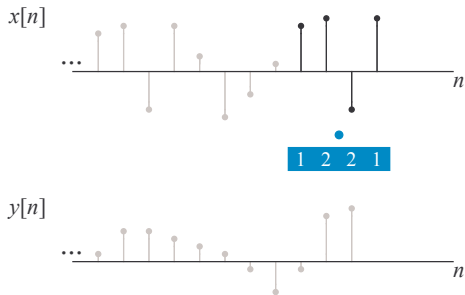
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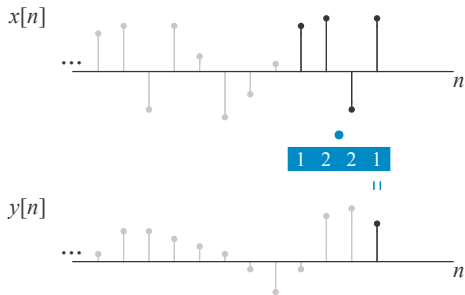
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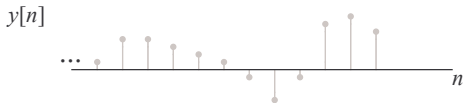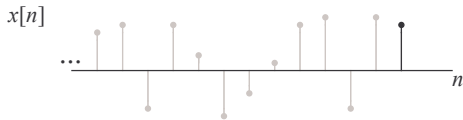
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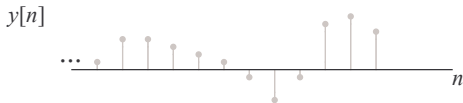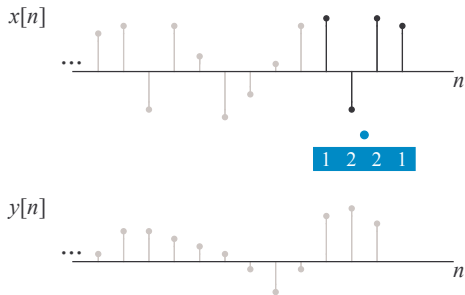$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

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Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
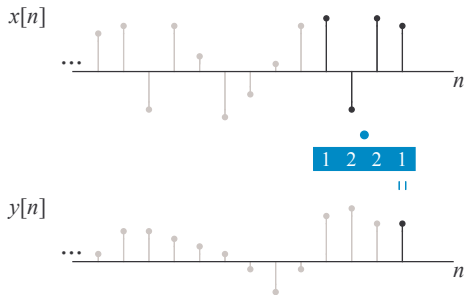
$$y[n] \; = \; x[n] \; + \; 2x[n-1] \; + \; 2x[n-2] \; + \; x[n-3]$$

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
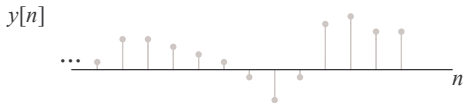
$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
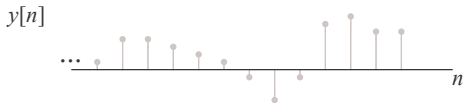
$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
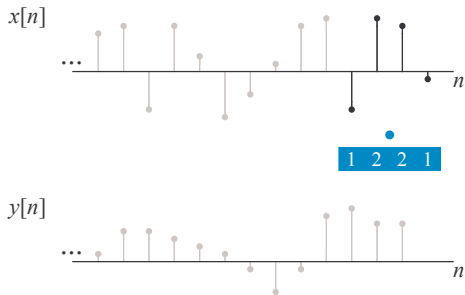
$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation
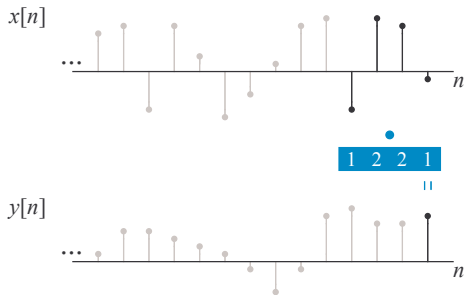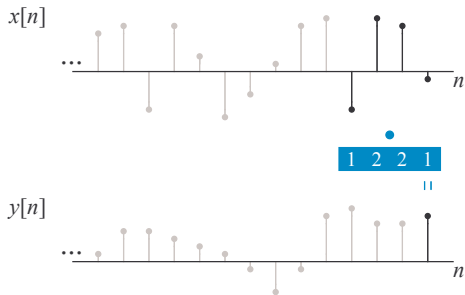
$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Moving-average

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation

$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Moving-average filter

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation

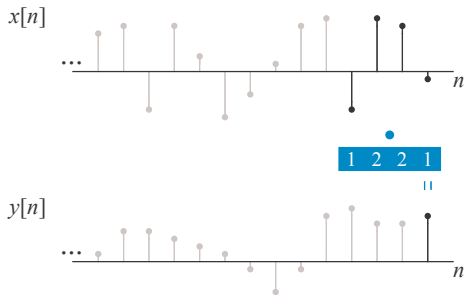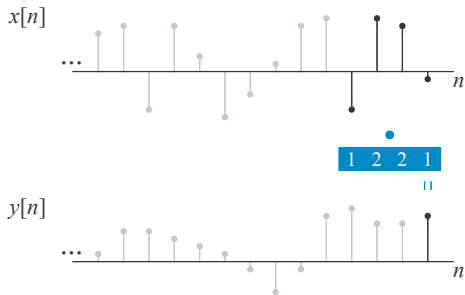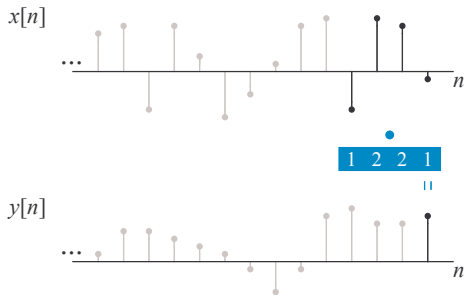$$y[n] = x[n] + 2x[n-1] + 2x[n-2] + x[n-3]$$

Moving-average filter; also known as FIR

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation

$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Moving-average filter; also known as FIR (finite-duration

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation

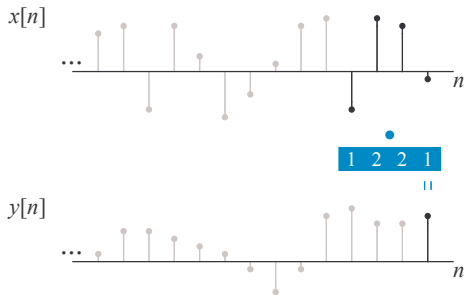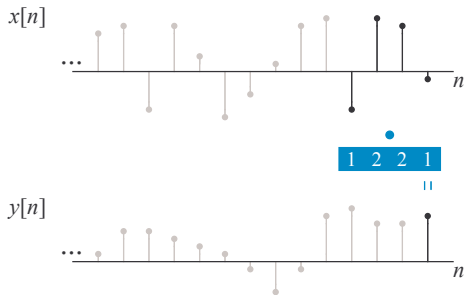$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Moving-average filter; also known as FIR (**f**inite-duration **i**mpulse

Introductory Example

Filter acts on the input sequence $x[\cdot]$ to produce the output sequence $y[\cdot]$, according to the equation

$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

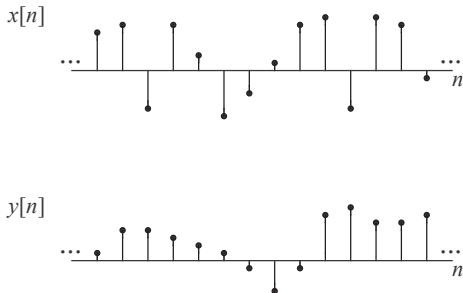

Moving-average filter; also known as FIR (finite-duration impulse response).

Introductory Example

Filter acts on the input sequence $x[\,\cdot\,]$ to produce the output sequence $y[\,\cdot\,]$, according to the equation

$$y[n] \;=\; x[n] \;+\; 2x[n-1] \;+\; 2x[n-2] \;+\; x[n-3]$$

Moving-average filter; also known as FIR (**f**inite-duration **i**mpulse **r**esponse).