Signal Processing - 1 by One

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Outline

- So Far: Sampling and Convolution
- Fourier Analysis
- Previous Week: Sampling and DTFT
- Today: DTFT and Circular Convolution

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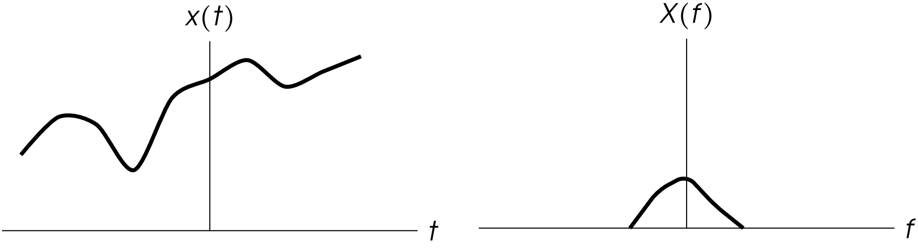
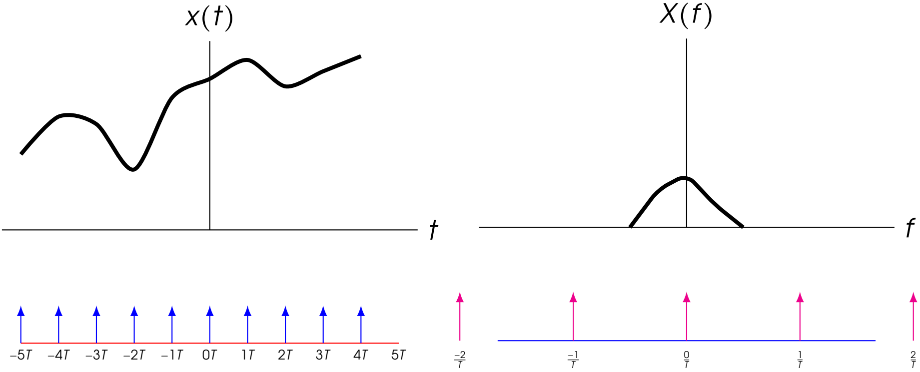
DTFT Illustration



DTFT Illustration



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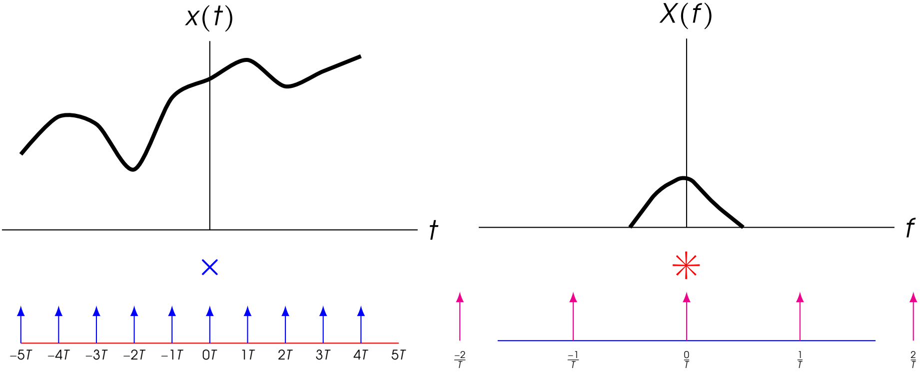

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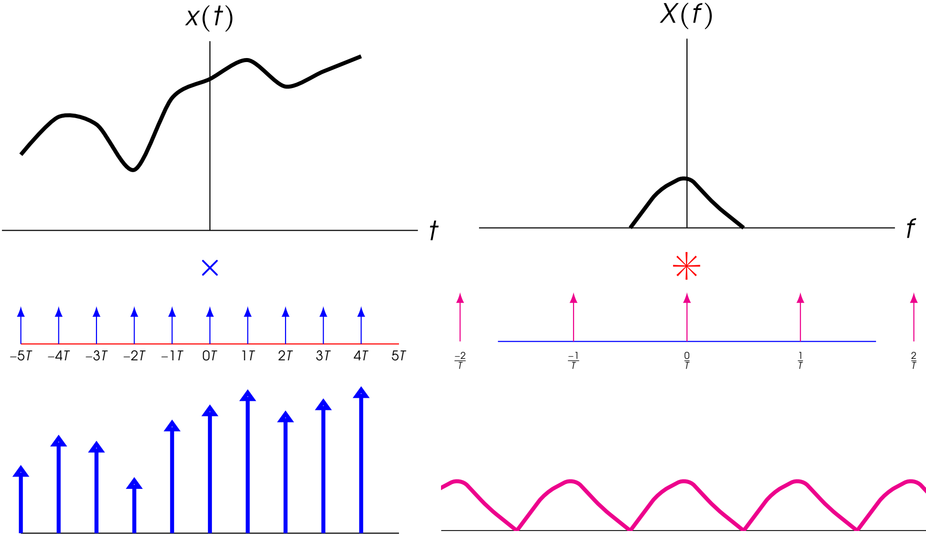

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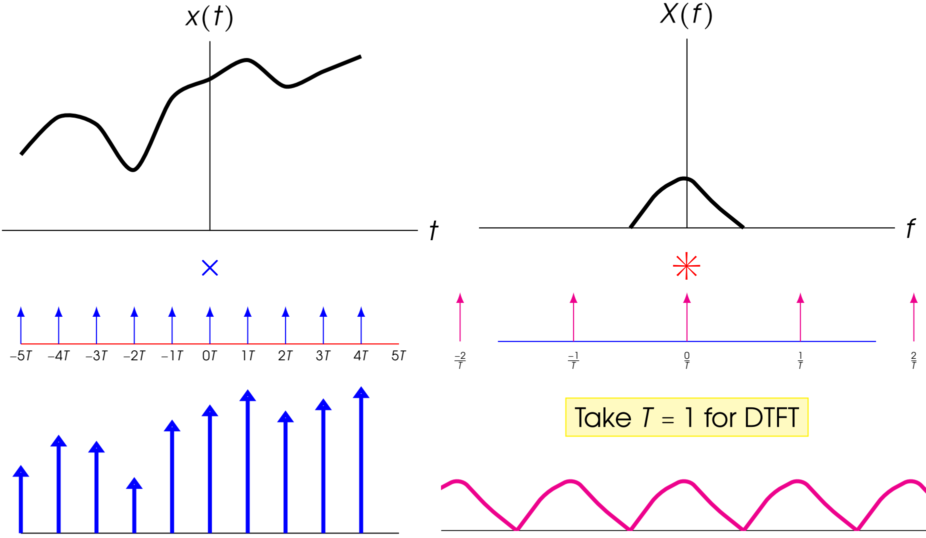
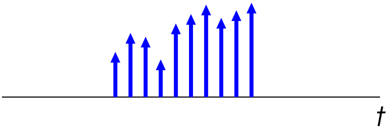
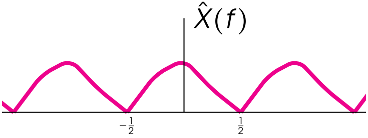


DFT: Sampling DTFT





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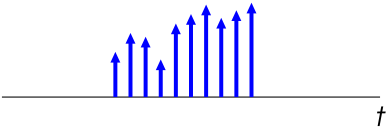

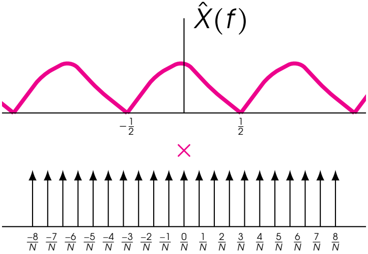

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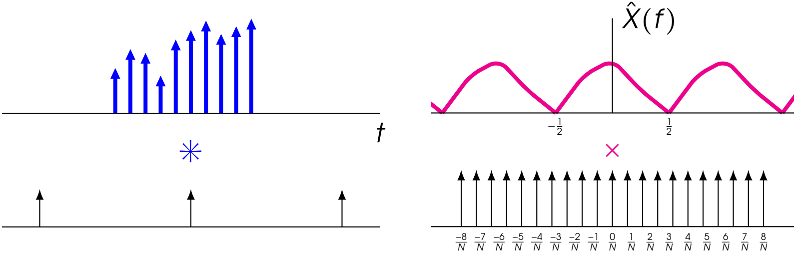

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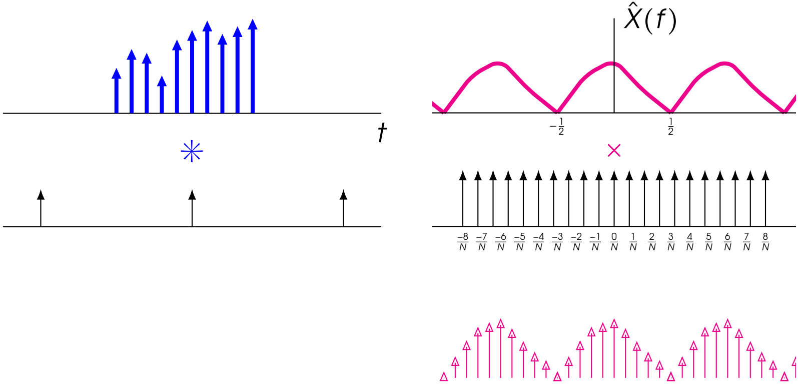

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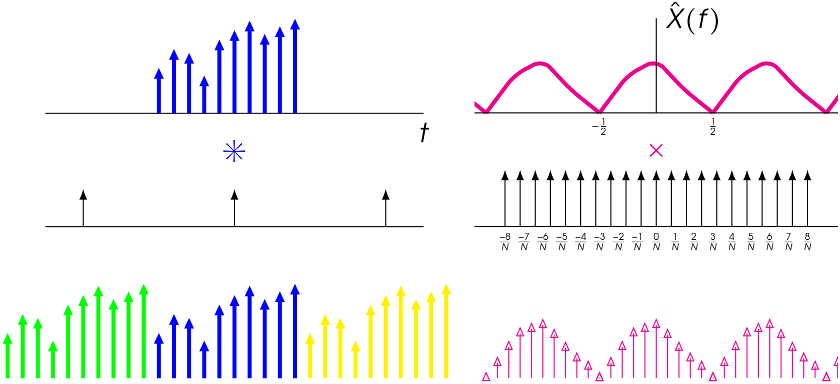
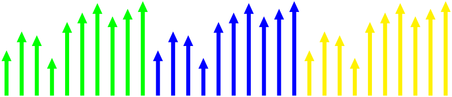


DFT: Discrete Fourier Transform

$$X[k] = \hat{X}\left(\frac{k}{N}\right) = \sum_{n=0}^{N-1} x[n] \exp\left(-j2\pi \frac{k}{N} n\right).$$

DFT-DTFT Product

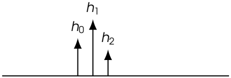
$x_c[n] = \sum_{l \in \mathbb{Z}} x[n + lN]$



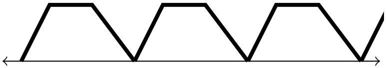
$X[k]$

$\ast$

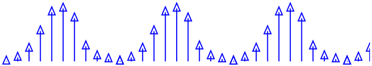
$\times$



$\hat{H}(f)$



$\hat{H}(\frac{k}{N})\hat{X}(\frac{k}{N})$



$y[n] = x_c[n] \ast h[n]$

Circular Convolution

$$x[n] \circledast h[n] \triangleq x_c[n] * h[n] \quad \text{“One period”}$$