Hanze
University of Applied Sciences
Groningen

Digital Signal Processing

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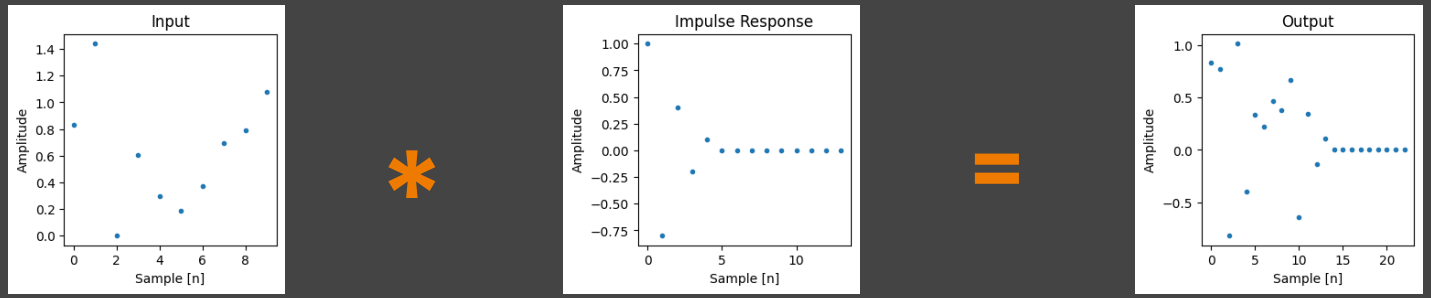
ewout bergsma.

Today

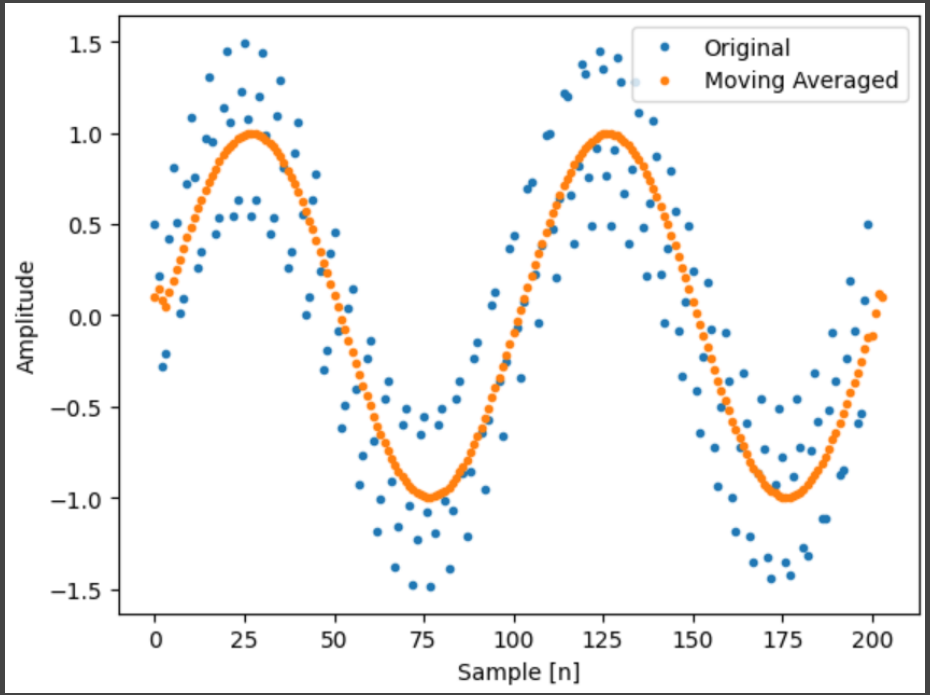
- Discrete Fourier Transform
- Exercises

So far

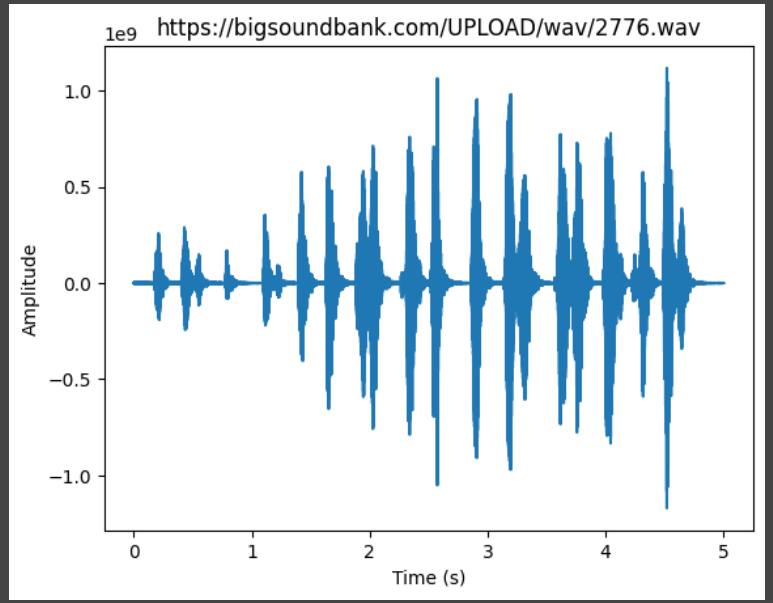
x[n] * h[n] = y[n]



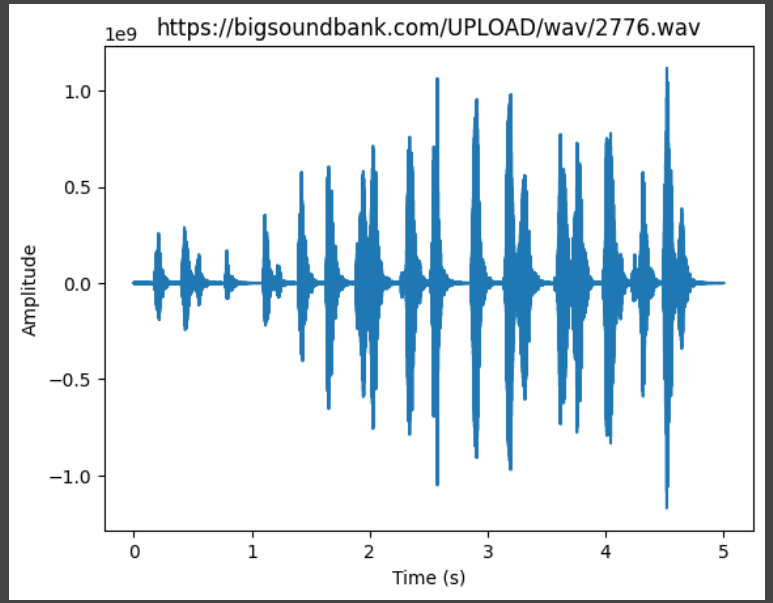
What we also did



You did your exercises, right?!

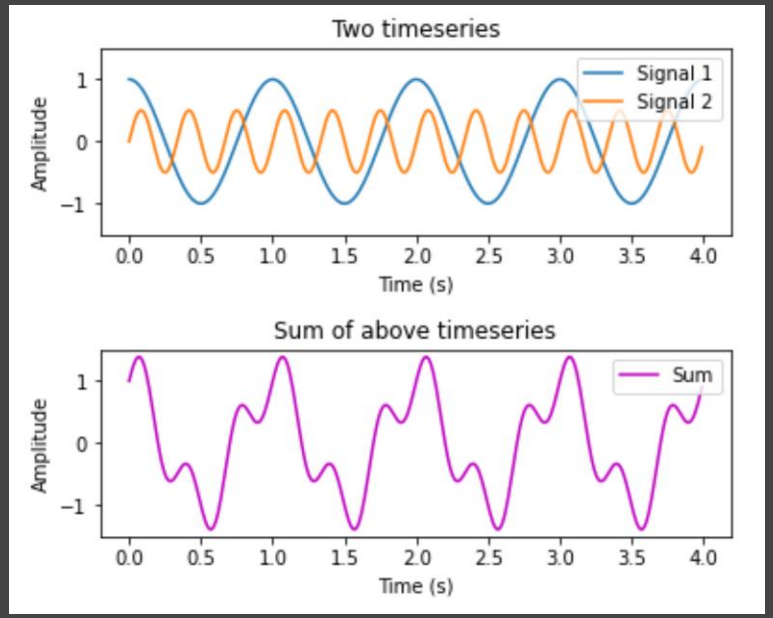

https://bigsoundbank.com/UPLOAD/wav/2776.wav
1e9
1.0
0.5
0.0
−0.5
−1.0
Amplitude
0
1
2
3
4
5
Time (s)

y[n]

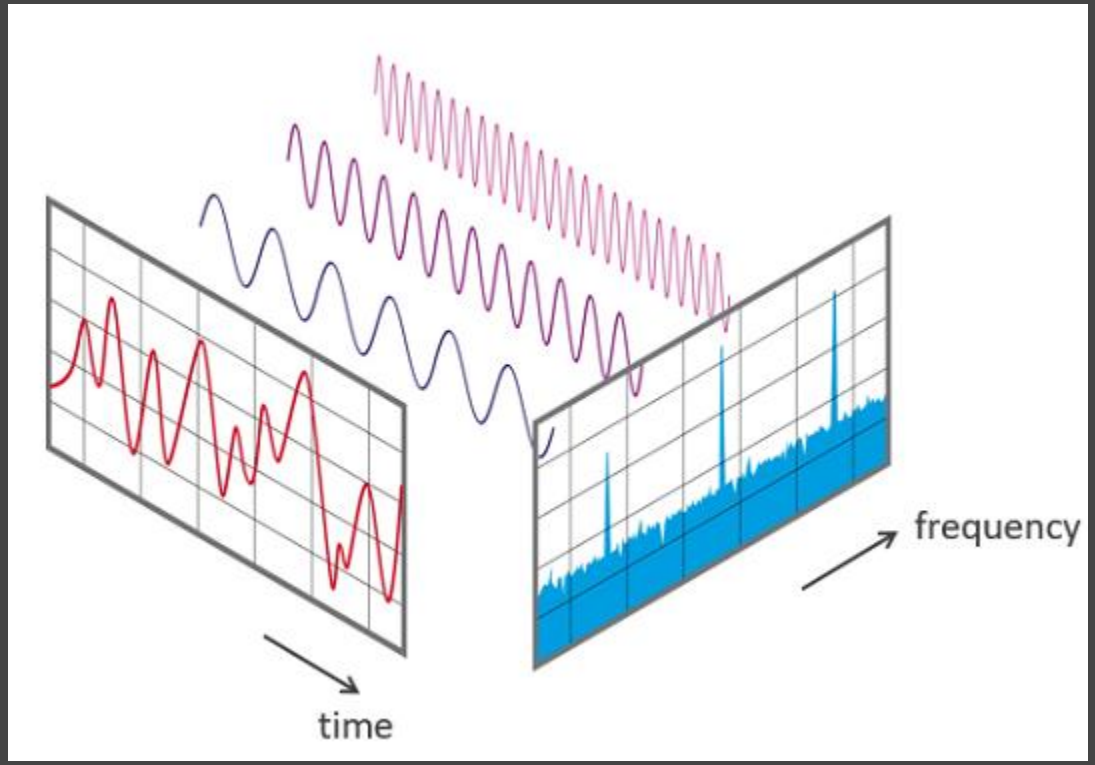

1e9
https://bigsoundbank.com/UPLOAD/wav/2776.wav
1.0
0.5
0.0
−0.5
−1.0
Amplitude
0
1
2
3
4
5
Time (s)

x[n]?

h[n]?

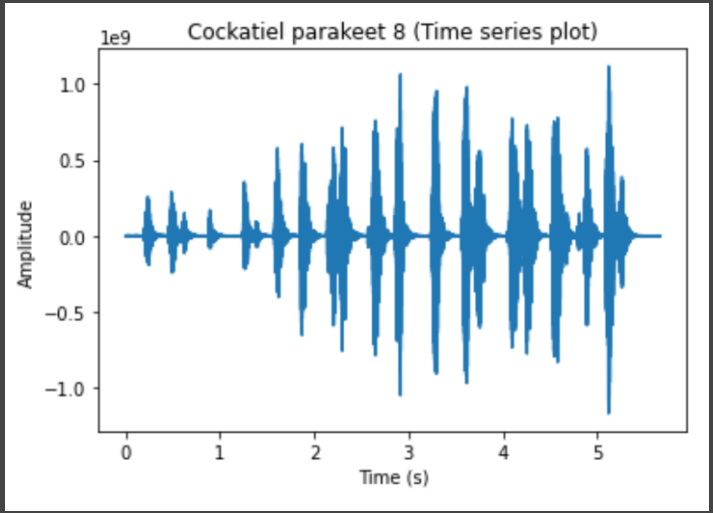

Two timeseries
Signal 1
Signal 2
Amplitude
Time (s)
Sum of above timeseries
Sum
Amplitude
Time (s)

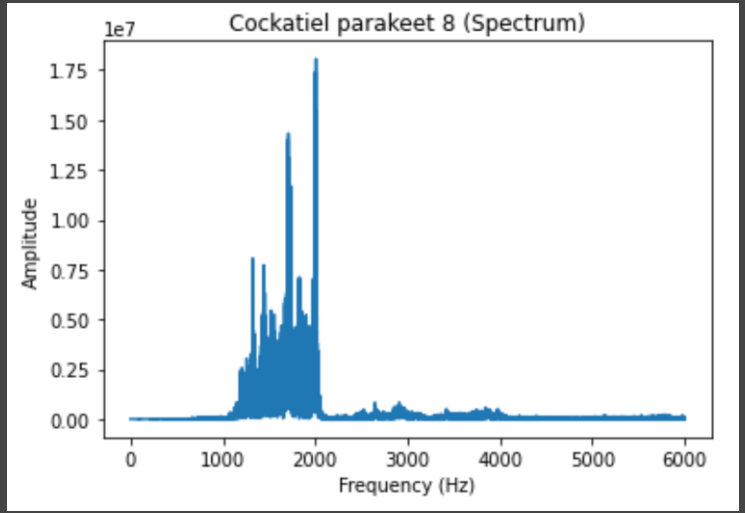
?



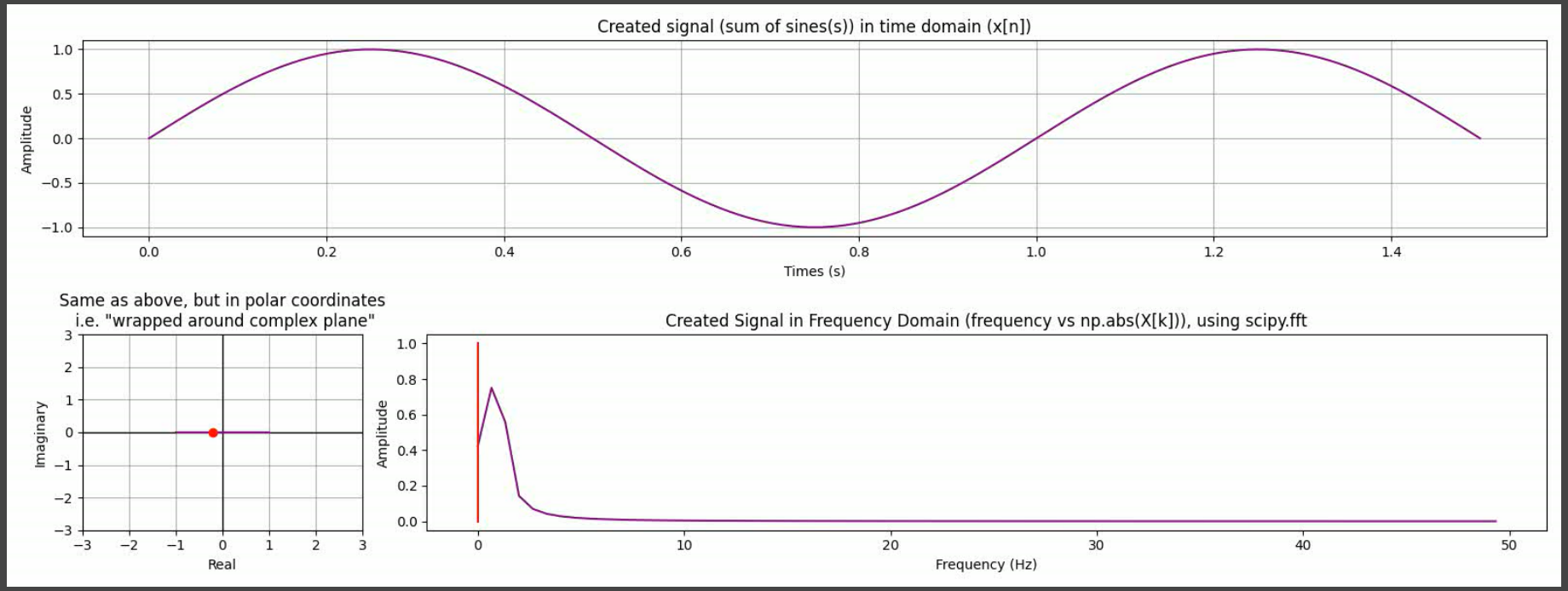
Source: https://www.nti-audio.com/en/support/know-how/fast-fourier-transform-fft

Source: https://en.wikipedia.org/wiki/Joseph_Fourier

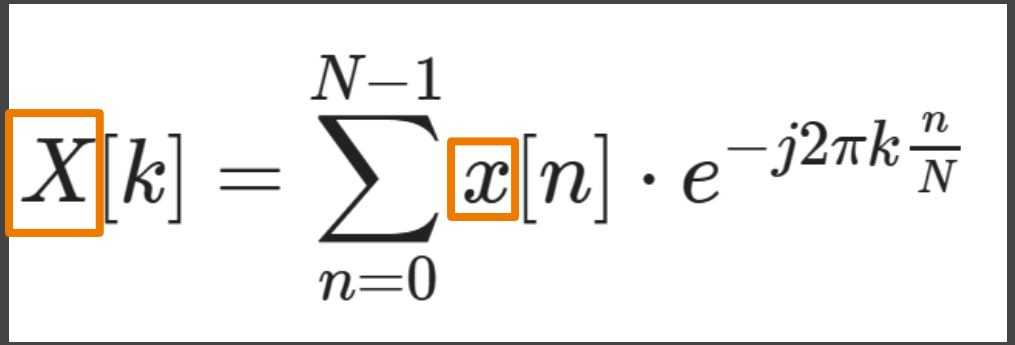

Cockatiel parakeet 8 (Time series plot)
1e9
1.0
0.5
0.0
−0.5
−1.0
Amplitude
0
1
2
3
4
5
Time (s)


Cockatiel parakeet 8 (Spectrum)
1e7
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Amplitude
0
1000
2000
3000
4000
5000
6000
Frequency (Hz)

$$X[k] = \sum_{n=0}^{N-1} x[n] \cdot e^{-j2\pi k \frac{n}{N}}$$



Source: https://github.com/EwoutBergsma/Interactive-Fourier-Transform-Visualisation


$X[k] = \sum_{n=0}^{N-1} x[n] \cdot e^{-j2\pi k \frac{n}{N}}$

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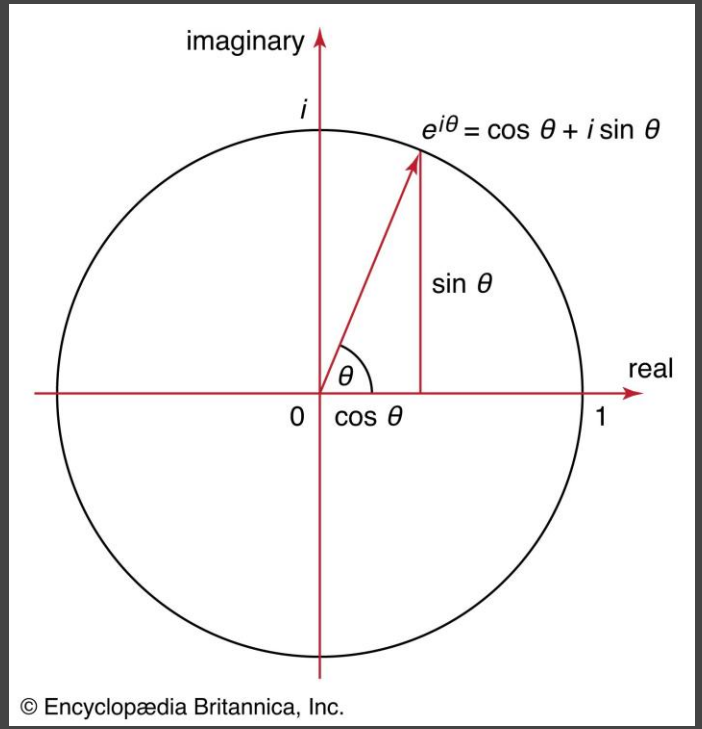

Source: https://www.britannica.com/science/Eulers-formula

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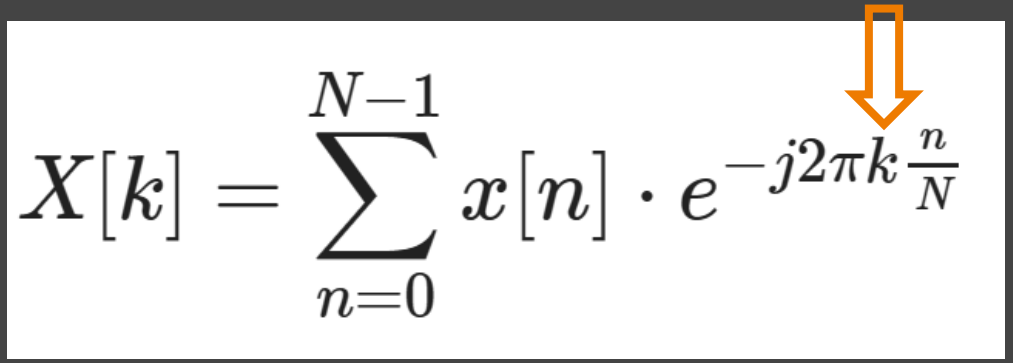
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Exercises!