The Fast Fourier Transform (FFT)

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What is FFT?

To get started, a series of concepts should be briefly introduced the discrete Fourier transform or the DFT.

What is DFT?

What is DFT?

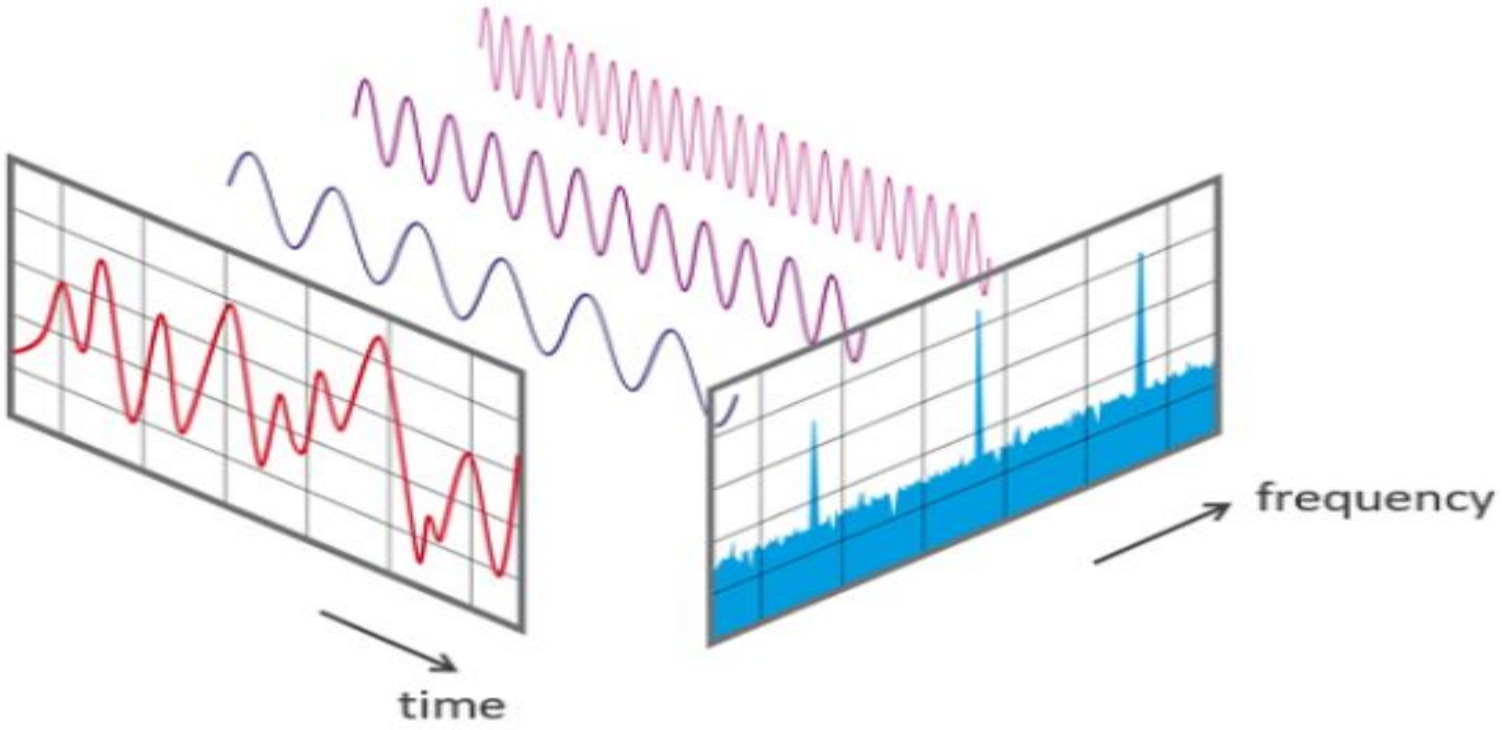
$$F(t) = \sum_{x=0}^{N-1} f(x) e^{-i\frac{2\pi t x}{N}}$$

<When N=4>

t=0

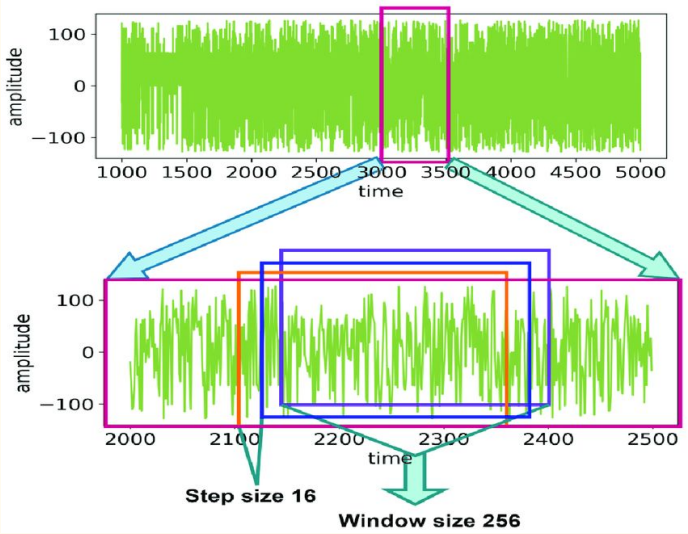
$$\begin{bmatrix} F(0) \\ F(1) \\ F(2) \\ F(3) \end{bmatrix} = \begin{bmatrix} e^{-i\frac{0}{4}} & e^{-i\frac{0}{4}} & e^{-i\frac{0}{4}} & e^{-i\frac{0}{4}} \\ e^{-i\frac{0}{4}} & e^{-i\frac{2\pi}{4}} & e^{-i\frac{4\pi}{4}} & e^{-i\frac{6\pi}{4}} \\ e^{-i\frac{0}{4}} & e^{-i\frac{4\pi}{4}} & e^{-i\frac{8\pi}{4}} & e^{-i\frac{12\pi}{4}} \\ e^{-i\frac{0}{4}} & e^{-i\frac{6\pi}{4}} & e^{-i\frac{12\pi}{4}} & e^{-i\frac{18\pi}{4}} \end{bmatrix} \begin{bmatrix} f(0) \\ f(1) \\ f(2) \\ f(3) \end{bmatrix}$$

x=0



View of a signal in the time and frequency domain

FFT



What is FFT?

Why we need FFT?

Who invented FFT?

Uses of FFT?

What is FFT?

Why we need FFT?

Order of time.

DFT : O(n^2)

FFT : O(n log(n))

Example: n = 60*30*10^3 = 1.8*10^6

DFT : 3.24*10^12 = 1day

FFT : 2.59*10^7 = less then 1sec.

Who invented FFT?

Uses of FFT?

Uses of FFT?

- to compute derivatives
- to solve complicated PDE s that describe real-world.
- denoise data
- data analysis
- audio and images compression.