

THE FOURIER TRANSFORM



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- Introduction
- The Fourier Transform
- Questions

Introduction

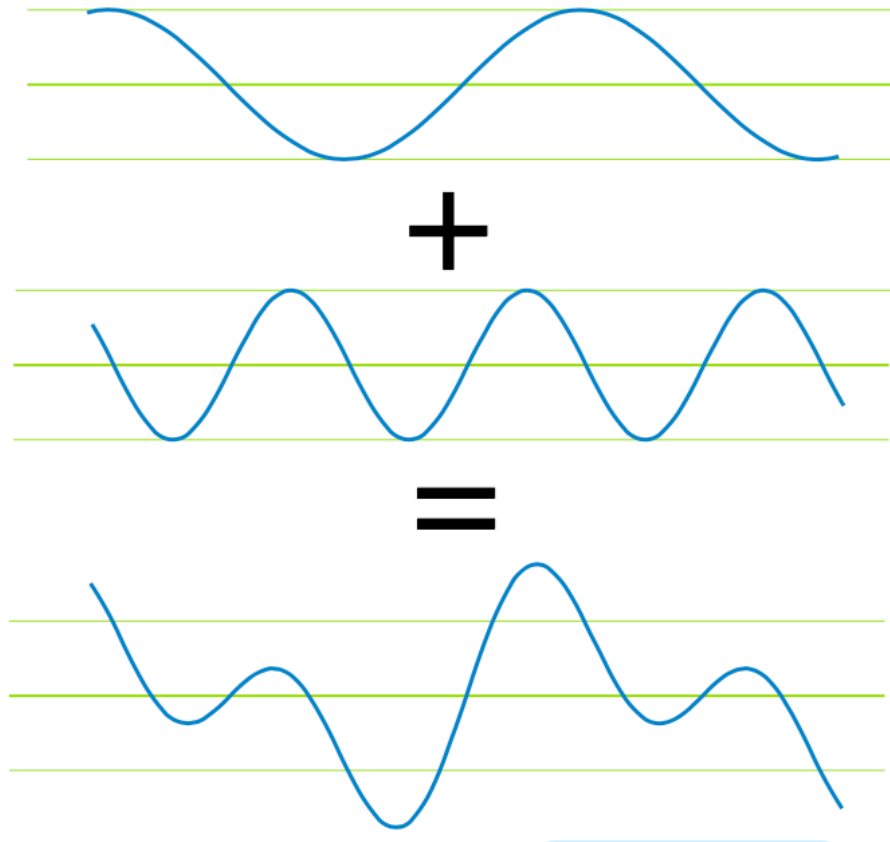
What is the Fourier Transform?

The Fourier Transform is important in mathematics, engineering, and the physical sciences. The Discrete Fourier Transform (DFT) which is computed by making use of the Fast Fourier Transform (FFT) has changed modern society, since it is used in digital electronics and signal processing.

Radio Astronomers are keen users of the Fourier Transform because it is a key component in data and signal processing.

The Fourier Transform

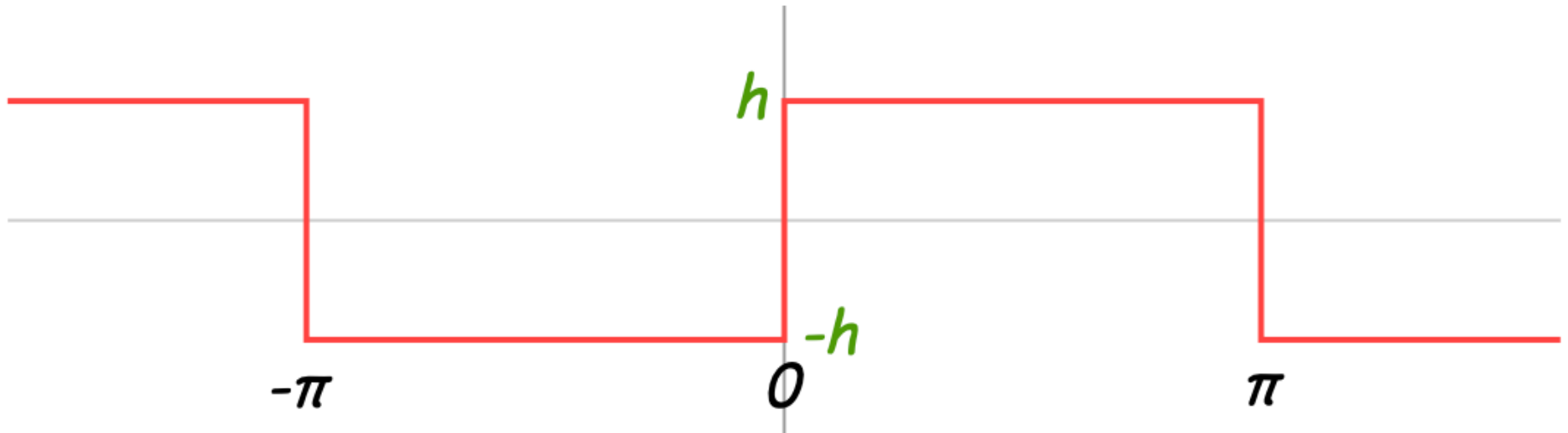
We can add sine waves together to form a new sine wave



The Fourier Transform

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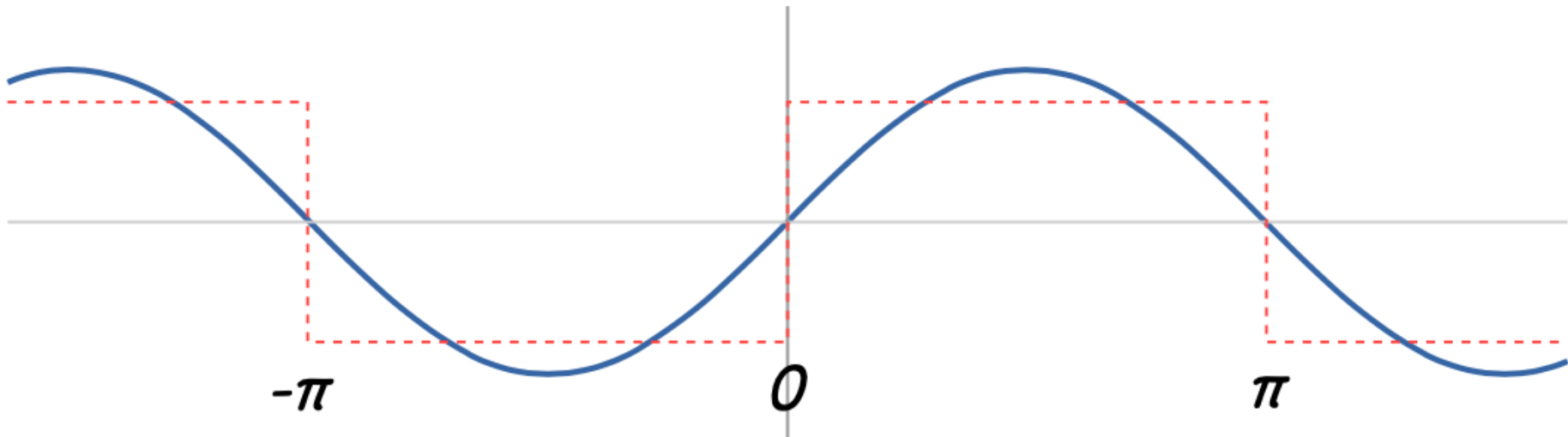
We want to add together sine waves to create a square wave



The Fourier Transform

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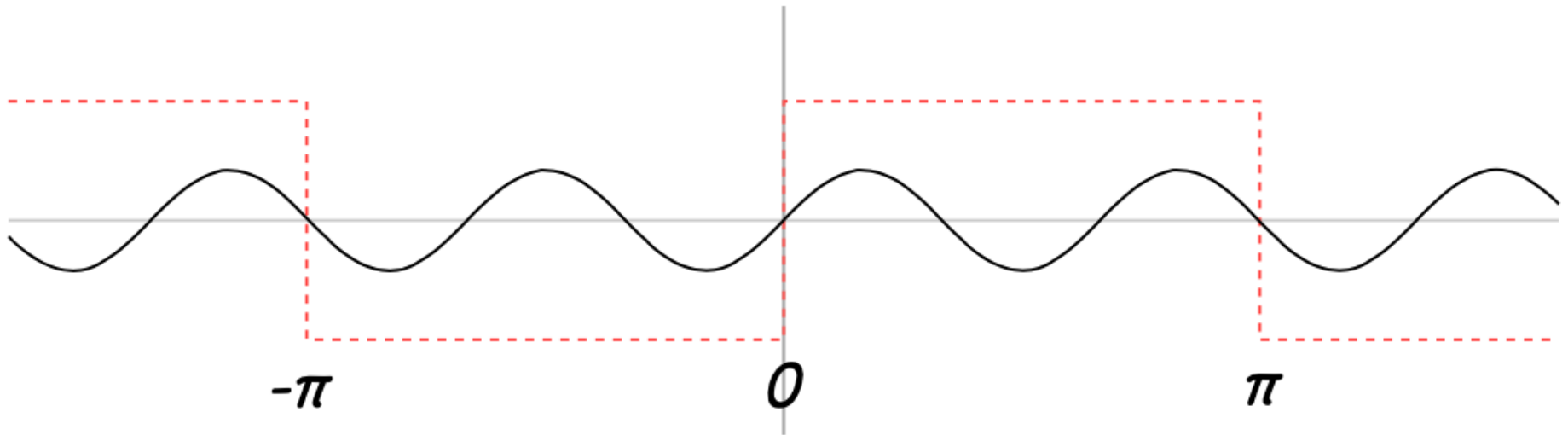
We start with $\sin(x)$



The Fourier Transform

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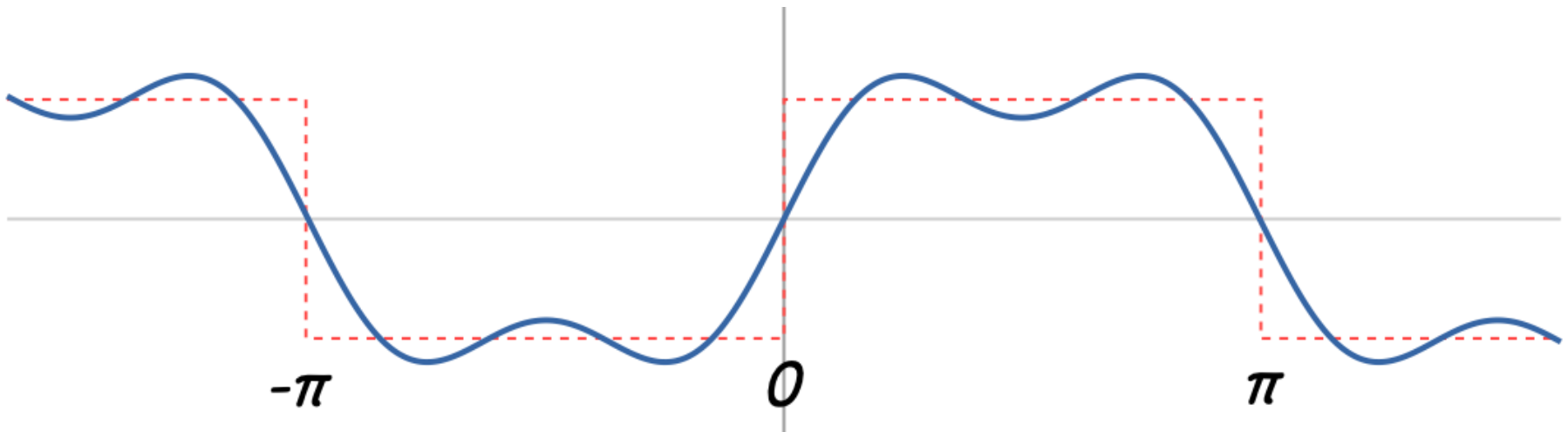
Then take $\sin(3x)/3$:



The Fourier Transform

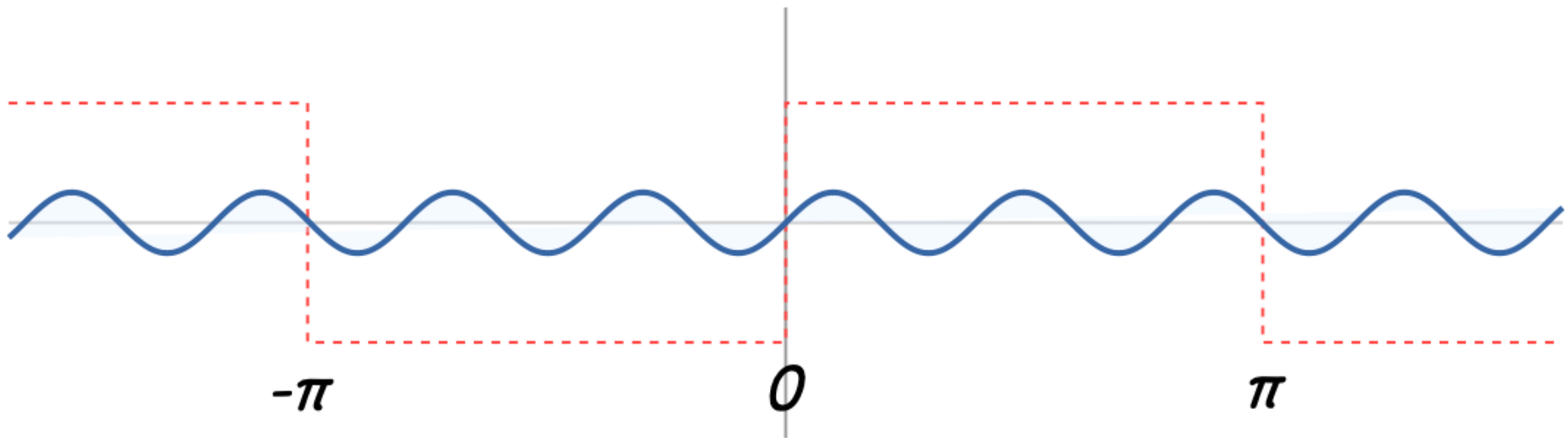
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Now we add $\sin(x)$ and $\sin(3x)/3$



The Fourier Transform

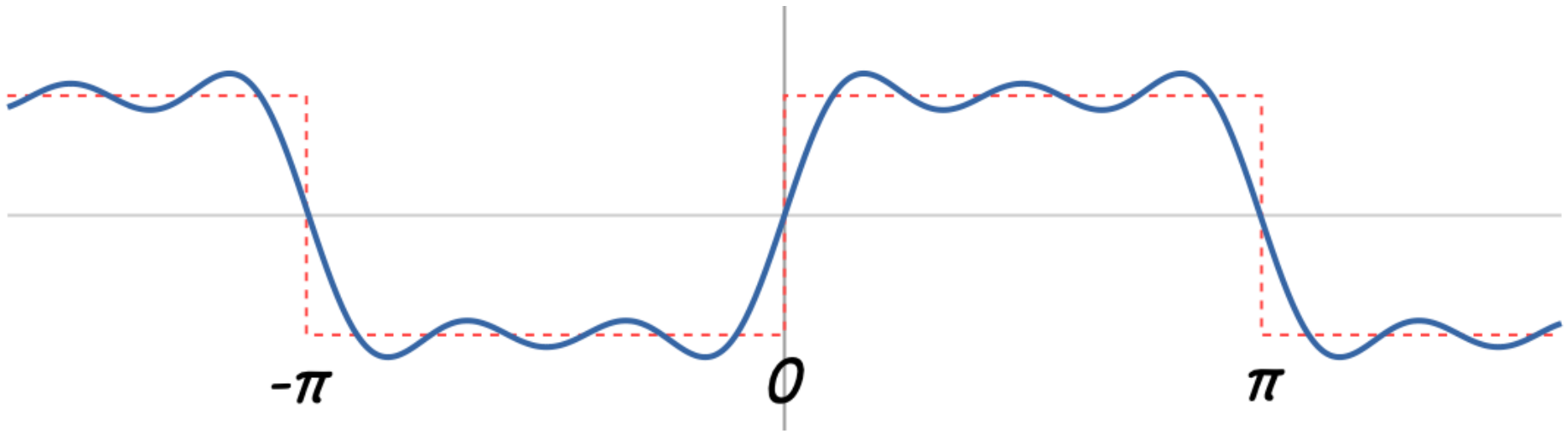
We use $\sin(5x)/5$



The Fourier Transform

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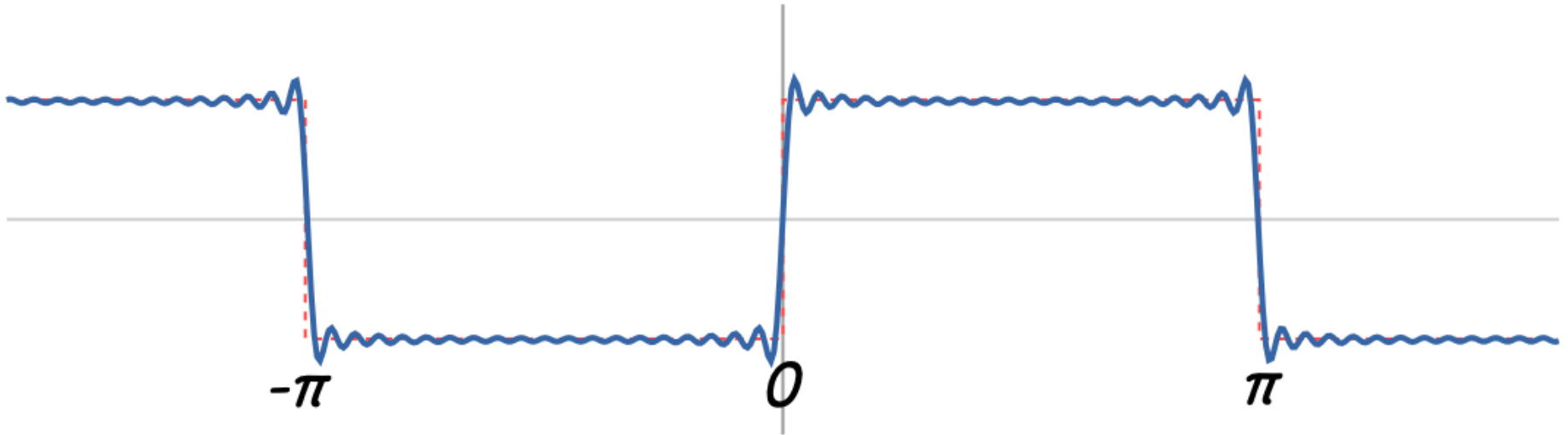
Now we add $\sin(x)$ and $\sin(3x)/3$ and $\sin(5x)/5$



The Fourier Transform

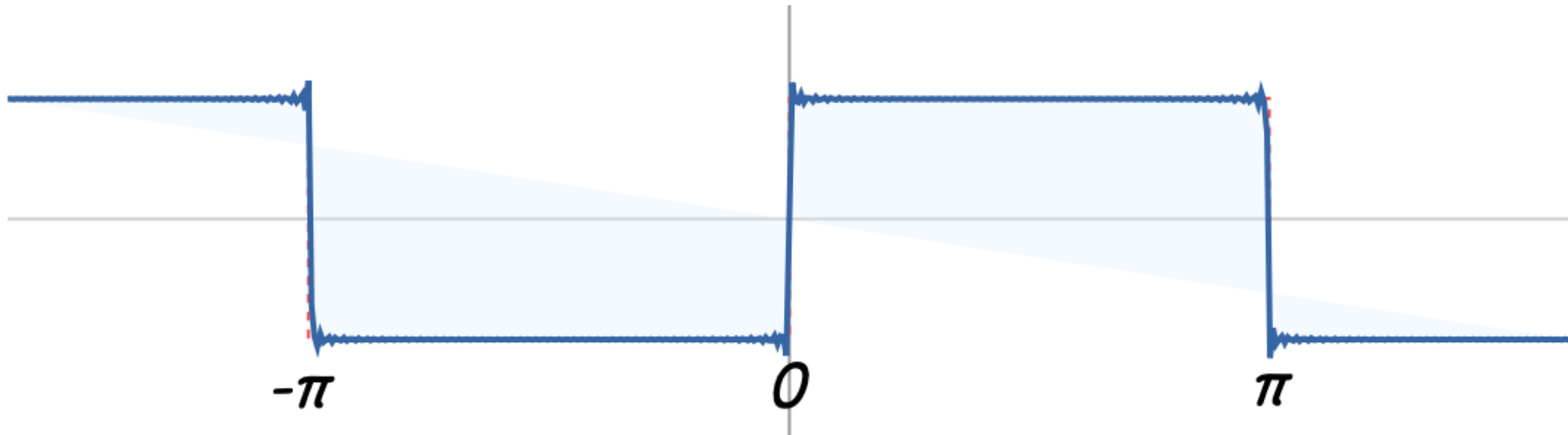
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When we add 20 sine waves together



The Fourier Transform

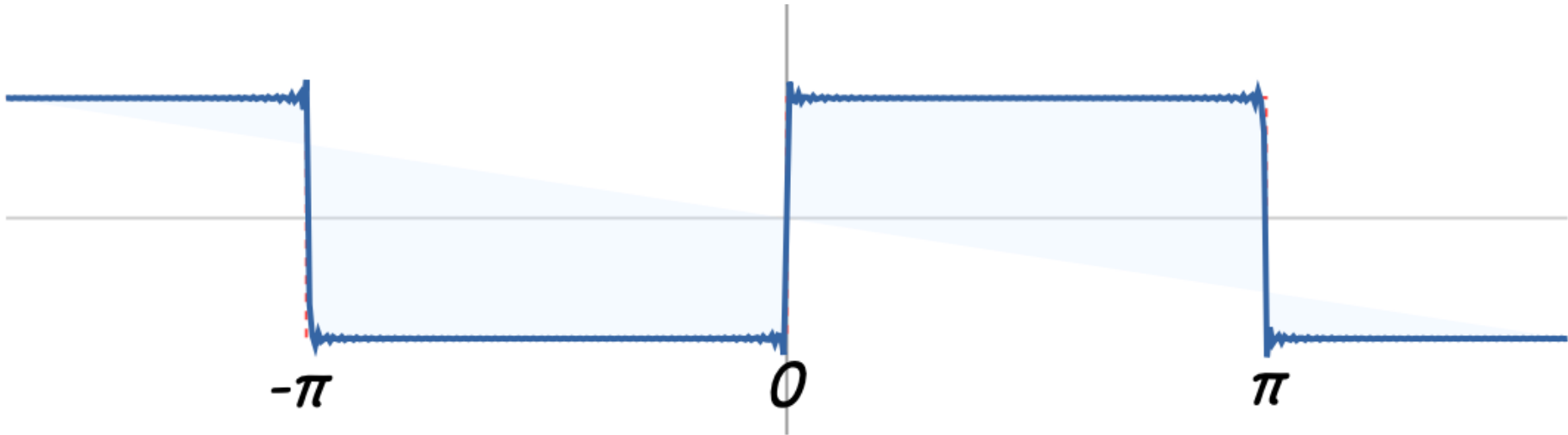
When we add 100 sine waves together



The Fourier Transform

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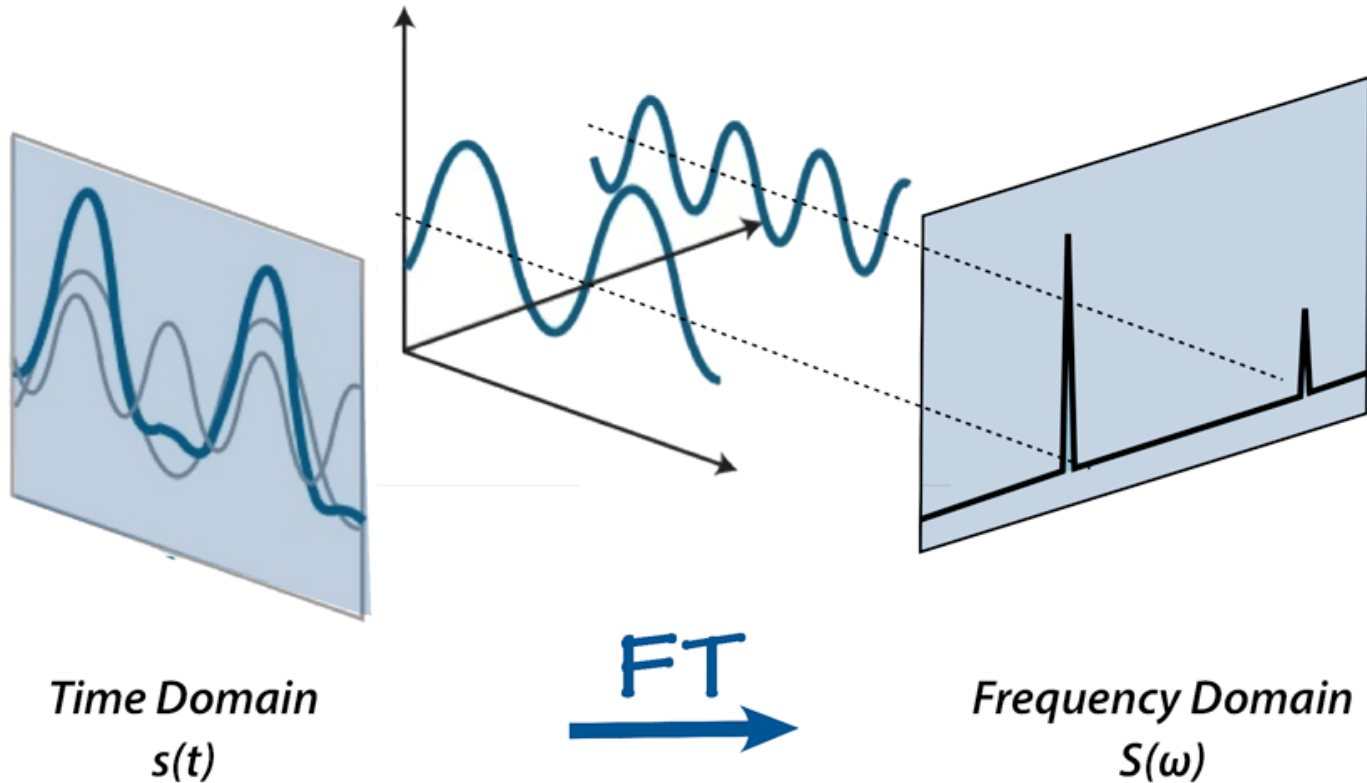
When we add 100 sine waves together



The Fourier Transform

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The Fast Fourier Transform (FFT)



The Fourier Transform

The Fourier Transform Equation

$$F(s) \equiv \int_{-\infty}^{\infty} f(x) e^{-2\pi i s x} dx ,$$

The Fourier Transform

The Inverse Fourier Transform Equation

$$f(x) \equiv \int_{-\infty}^{\infty} F(s) e^{2\pi i s x} ds ,$$

The Fourier Transform

Euler's Formula

$$e^{i\phi} = \cos \phi + i \sin \phi,$$

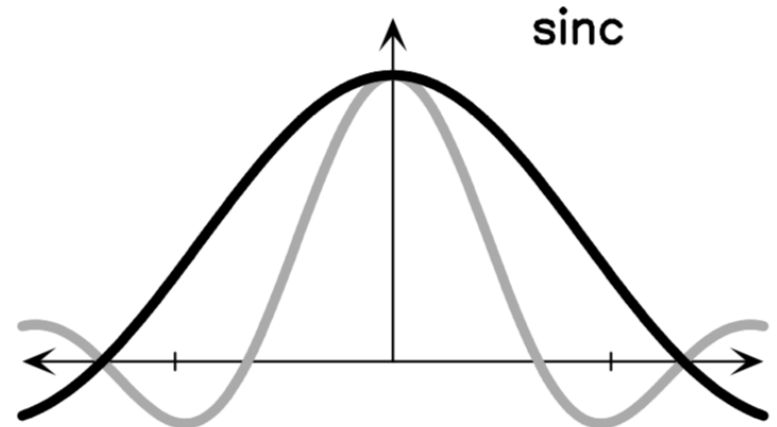
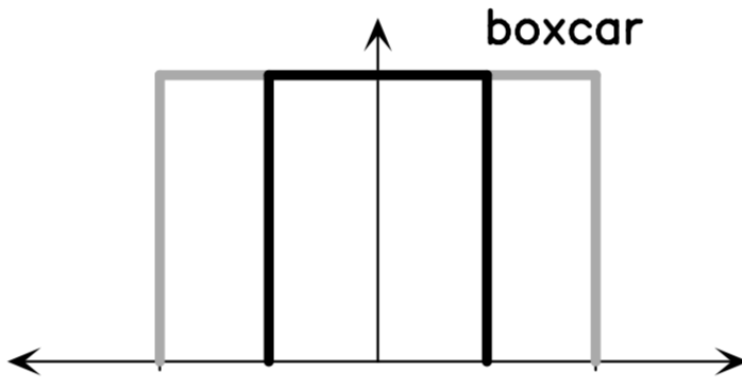
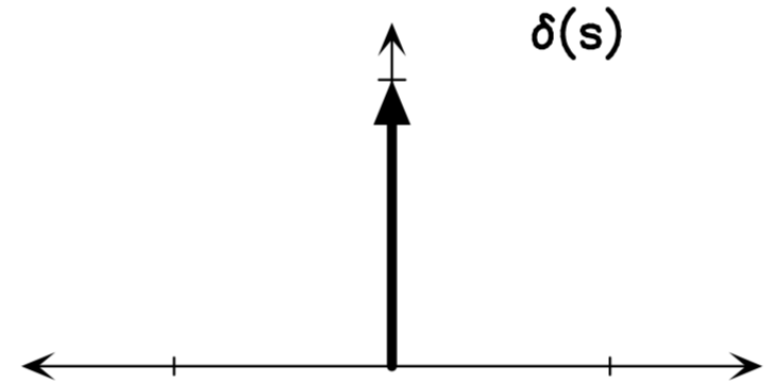
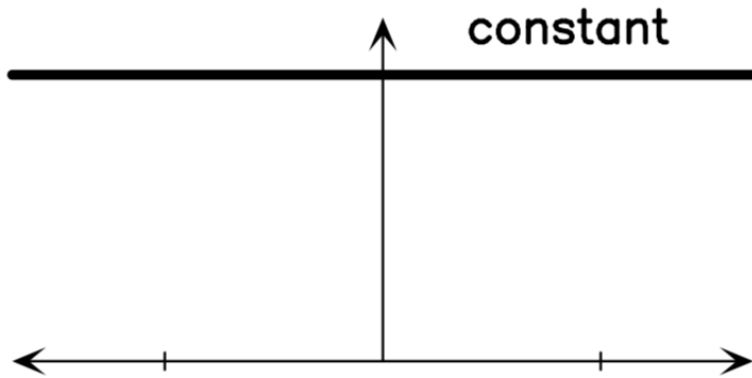
The Fourier Transform

Euler's Formula

$$e^{i\phi} = \cos \phi + i \sin \phi,$$

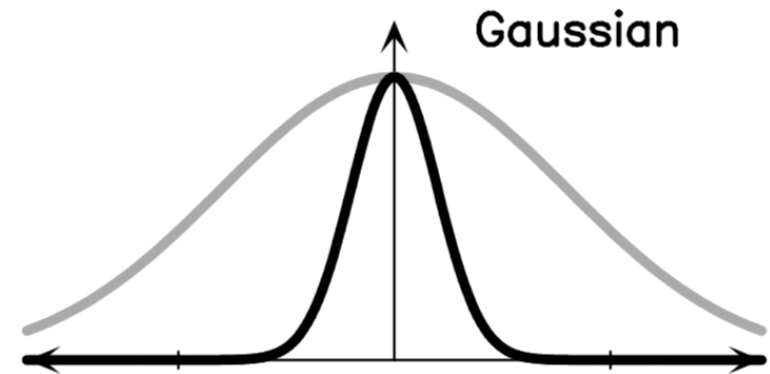
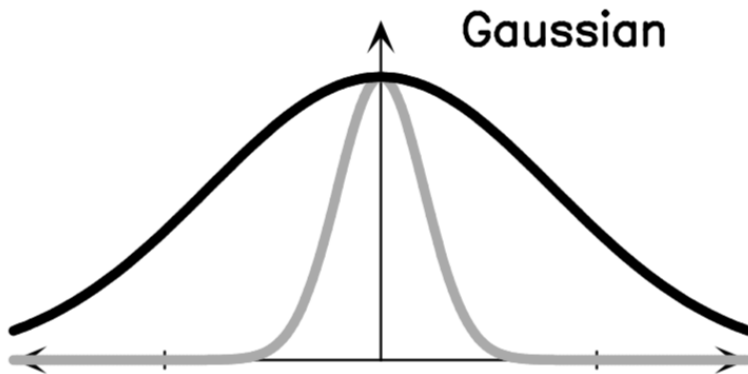
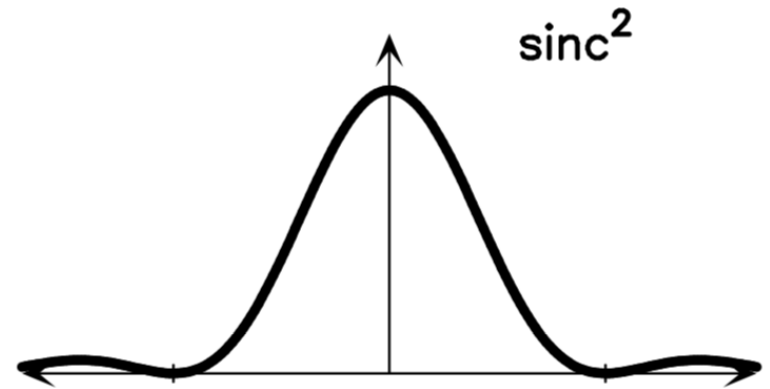
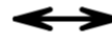
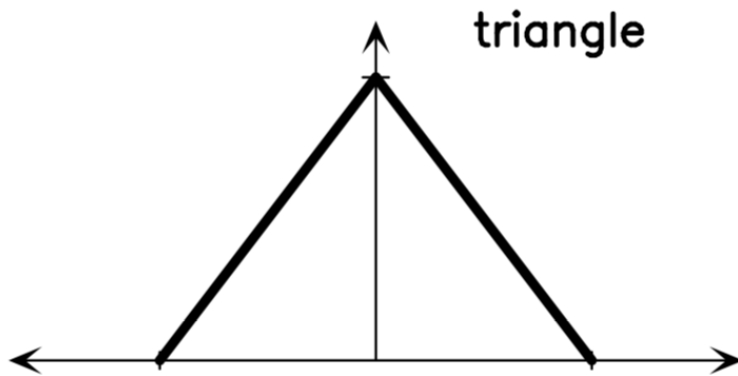
The Fourier Transform

Basic Fourier transforms



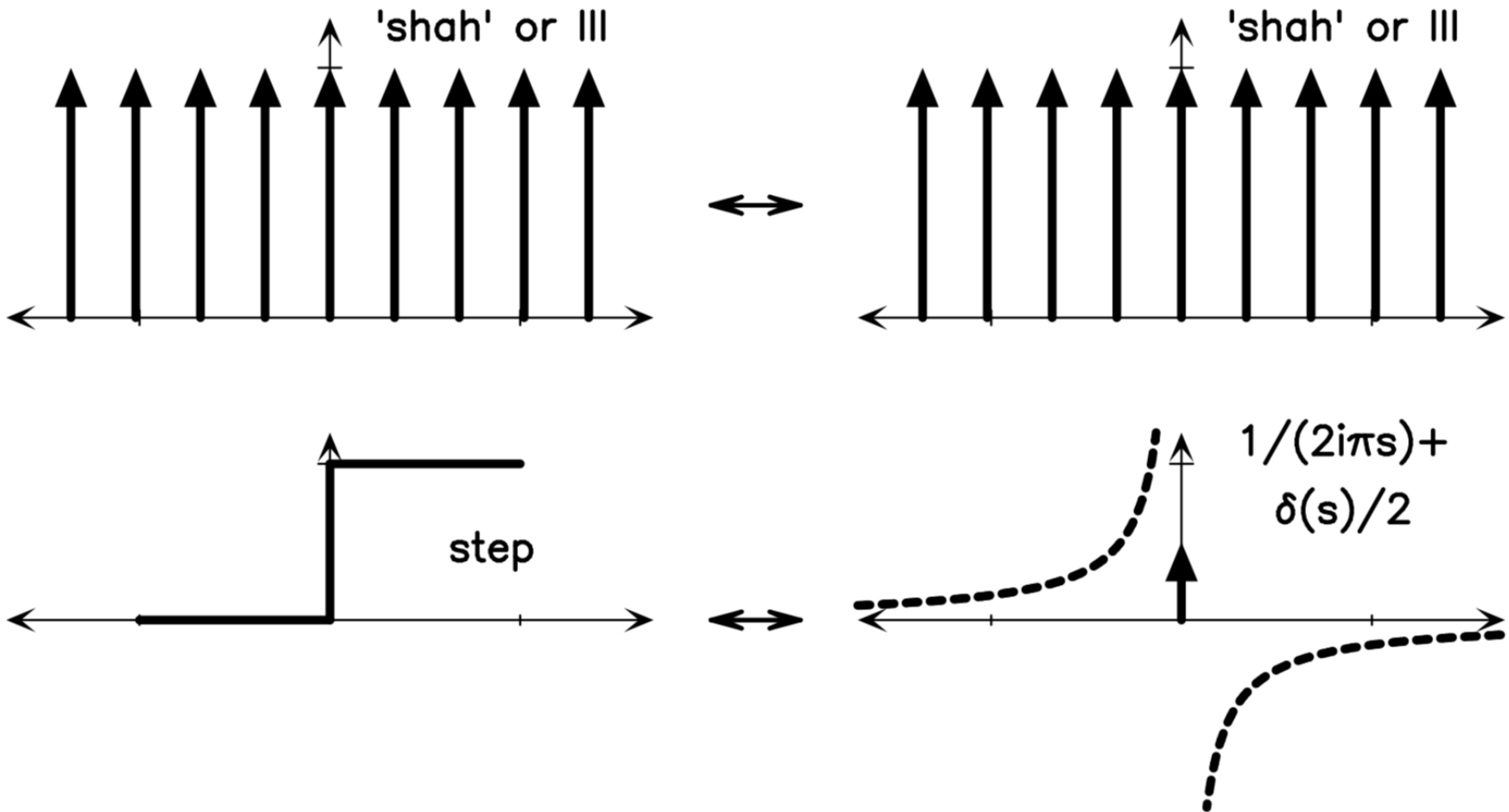
The Fourier Transform

Basic Fourier transforms



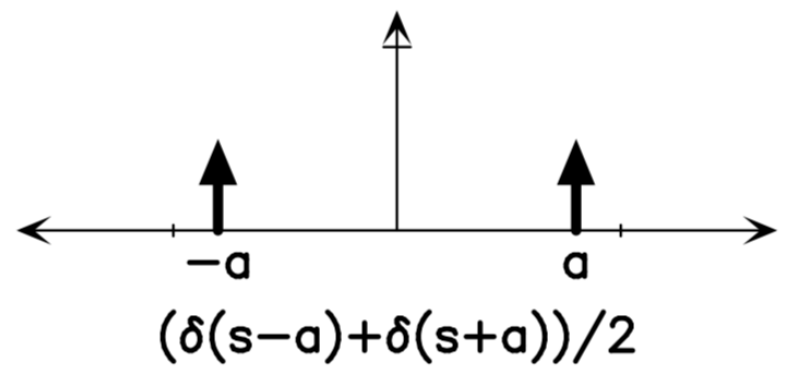
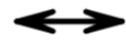
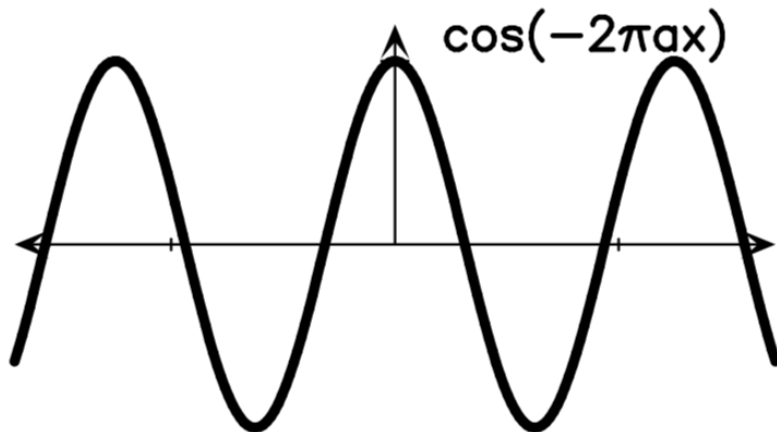
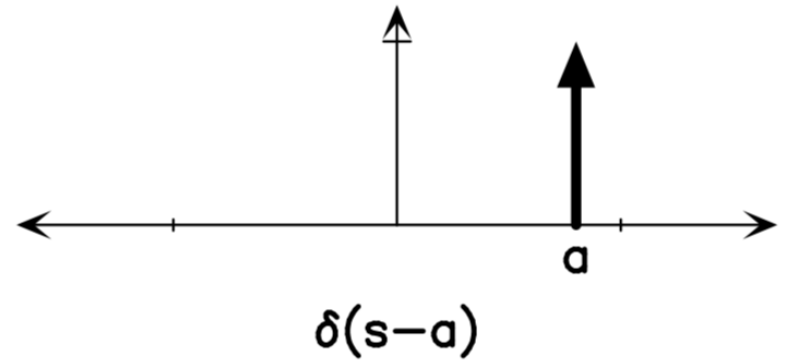
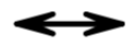
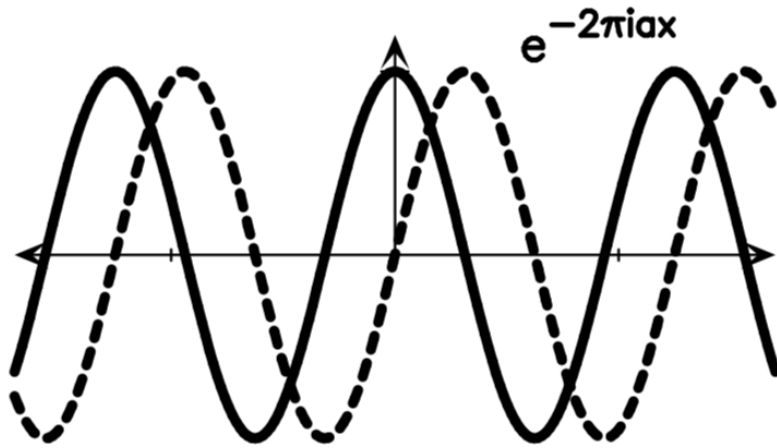
The Fourier Transform

Basic Fourier transforms



The Fourier Transform

Basic Fourier transforms



The Fourier Transform

The Fourier Transform Demonstrations:



Questions

