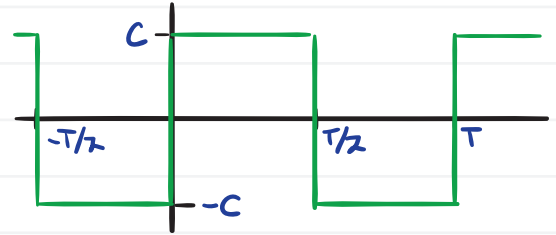


Fourier series example

020 | 1/2

Consider the square wave function

$$y(t) = \begin{cases} C & \text{for } 0 \leq \text{mod}(t, T) < T/2 \\ -C & \text{for } T/2 \leq \text{mod}(t, T) < T. \end{cases}$$



We will perform a Fourier series analysis of this function and synthesize the first number of harmonics to see how well they approximate $y(t)$.

Fourier analysis

We apply the equations of Fourier analysis:

Aside

Fourier synthesis

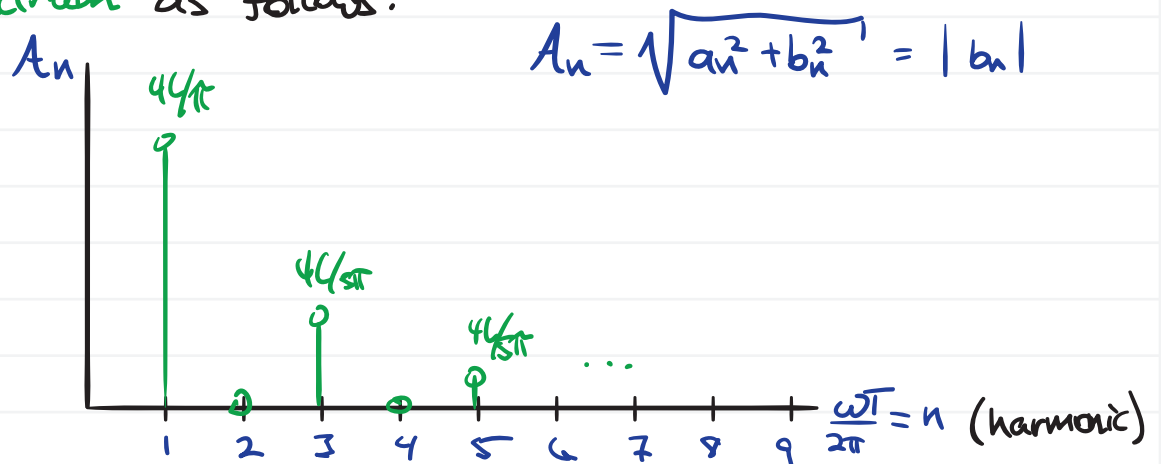
We can now synthesize the first p terms of the series. The full series is

We can say that, for sufficiently large p ,

$$y(t) \approx \sum_{n=1}^p b_n \sin \frac{2\pi n t}{T} .$$

Let's compute the first few harmonic amplitudes:

We can visualize these harmonic contributions on a **frequency spectrum** as follows.



Thinking about a signal $y(t)$ in terms of its harmonics and its frequency spectrum is common practice.