2. Recall Fourier series

Recall that for any function $f(t)$ that is periodic and has period 2π, the Fourier series is given by

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt),$$

where the formulas for the coefficients a_n and b_n are given by

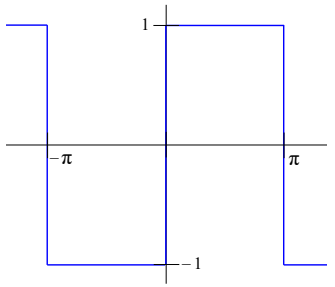
$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t) \cos(nt)\ dt,$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t) \sin(nt)\ dt$$

By virtue of the fact that we have formulas for the coefficients, a function has only one Fourier series. That is, if $f(t) = g(t)$, then the Fourier series for $f(t)$ is the same as the Fourier series for $g(t)$.

We will use this idea to come up with easier ways to compute Fourier series.

Here are the Fourier series of some 2π-periodic functions.

Name	Function	Fourier series	Graph
Square wave	$\mathrm{Sq}(t) = \begin{cases} 1 & 0 < t < \pi \\ -1 & -\pi < t < 0 \end{cases}$	$\mathrm{Sq}(t) = \frac{4}{\pi} \sum_{n \text{ odd}} \frac{\sin(nt)}{n}$	
Sawtooth wave	$W(t) = t, -\pi < t < \pi$	$W(t) = 2\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} \sin(nt)$	
Triangle wave	$T(t) = \lvert t \rvert, -\pi < t < \pi$	$T(t) = \frac{\pi}{2} - \frac{4}{\pi} \sum_{n \text{ odd}} \frac{\cos(nt)}{n^2}$	

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