Data Science
TD 2

Q. 1 Consider the following signal:

$$x(t) = 1 + \sin(4\pi t) + 2\cos(4\pi t) + \cos\left(6\pi t + \frac{\pi}{4}\right)$$

(a) What is the fundamental pulsation ω_0?

(b) Compute its Fourier series:

Q. 2 Fourier Series of a periodic square wave

(a) Compute the Fourier series of the periodic signal of period T (taking $\omega_0 = \frac{2\pi}{T}$):

$$x(t) = \begin{cases} 1 & \text{if } |t| \leq L \\ 0 & \text{otherwise} \end{cases}$$

(b) Compute the Fourier series of the Dirac comb of period T:

$$y(t) = \sum_{k=-\infty}^{+\infty} \delta(t - kT)$$

(c) Compute the Fourier series of:

$$z(t) = y(t + T_1) - y(t - T_1)$$

(d) Derive the solution of question (a) from the answer of question (c)

(e) How many terms are needed to capture 95 % of the signal $x(t)$ power as a function of $\alpha = 2\frac{L}{T}$?