Homework 03

Exercises from the textbook:

8.1. Consider two consequtive discrete Fourier transforms:

$$\mathcal{F}_N : (y_k) \mapsto (Y_n) \text{ and } \mathcal{F}_n : (Y_n) \mapsto (z_l).$$

Compute z_l as a functoin of y_k.

8.2. Let (x_k) and (y_k) be two complex periodic sequences with period N such that

$$x_{N-k} = \bar{x}_k \text{ and } y_{N-k} = \bar{y}_k$$

for all integer k. Show that their discrete Fourier transforms (X_n) and $Y_n)$ are real and that they can be computed with a single transform of order N.

8.3. Compute the successive powers of the matrix Ω_N.

8.5. Calculate the discrete Fourier transform of the vector $x_k = k$,
$k = 0, 1, 2, \ldots, N-1$

Exercise about Hermite functions:

Let
$$h_n(t) = e^{t^2/2} \frac{d^n}{dt^n} e^{-t^2}, \quad n = 0, 1, 2, \ldots$$

Calculate the L^2 norm:

$$\int_{-\infty}^{\infty} h_n^2(t) dt.$$