The fast Fourier transform (FFT) algorithm requires $O(m \log_2 m)$ multiplications and $O(m \log_2 m)$ additions.

Suppose the number of data points is a power of 2, i.e., $m = 2^p$. Then, for $x_j = -\pi + \left(\frac{j}{m}\right)\pi$ with $j = 0, 1, \ldots, 2m-1$, we have $2m = 2^{p+1}$ points $\left\{(x_j, z_j)\right\}_{j=0}^{2m-1}$ where the z_j may be complex (we usually use y_j if they are real).

The FFT procedure computes the complex coefficients c_k in the formula

$$F(x) = \frac{1}{m} \sum_{k=0}^{2m-1} c_k e^{ikx},$$

where

$$c_k = \sum_{j=0}^{2m-1} y_j e^{\pi ijk/m}, \quad \text{for each } k = 0, 1, \ldots, 2m-1.$$

Then

$$\frac{1}{m} c_k e^{-i\pi k} = a_k + ib_k.$$

Maple. In Maple, FourierTransform in the Discrete Transforms Package uses

$$c_k = \frac{1}{\sqrt{m}} \sum_{j=0}^{2m-1} y_j e^{-2\pi ijk/m}, \quad \text{for each } k = 0, 1, \ldots, 2m-1,$$

so

$$a_k = (-1)^k \sqrt{\frac{2}{m}} \Re(c_k) \quad \text{and} \quad b_k = (-1)^k \sqrt{\frac{2}{m}} \Im(c_k).$$

See fft.mw or fft.pdf.