Source task and conventions

Write a MATLAB routine computing and plotting the DFT magnitude and phase of any nonempty finite sequence, including non-power-of-two lengths.

Conventional solution and proof

The delivered file `code/matlab/dftplots.m` validates a numeric finite vector, sets $N = \mathrm{numel}(x)$, computes $X = \mathrm{fft}(x)$ and uses the grid $\omega_k = 2\pi k/N$. Magnitude is $|X_k|$ and phase is $\arg X_k$; phase at numerically zero magnitude is marked undefined. The routine preserves the requested length: it does not silently zero-pad to a power of two. For $N = 1$, the single output is x_0. A direct defining-sum implementation is included as a small-input reference. The accompanying Python translation is executed against that reference on composite and prime lengths.

Structural or analytic derivation

For an arbitrary N, $kn = [k^2 + n^2 - (k-n)^2]/2$ gives

$$X_k = e^{-\pi i k^2/N} \sum_{n=0}^{N-1} \left(x_n e^{-\pi i n^2/N}\right) e^{\pi i (k-n)^2/N}.$$