

DFT in Matlab or Octave

The key to coding the DFT in Matlab or Octave (or any programming language) is to recognize that the DFT summation can be formulated as a matrix product. So coding the DFT involves generating the so-called W-matrix which is an N-by-N matrix of all of the complex exponential terms and then multiplying this matrix by the input sample vector as shown.

% function m-file to compute DFT
 % of an input sample sequence
 function S = dft(s)
 N = length(s);
 n = 0:N-1;
 k = n;
 W = k'*n;
 W = exp(-j*2*pi*W/N);
 S = W*s;

$$S(k) = \sum_{n=0}^{N-1} s(n) e^{-j2\pi kn/N}$$

$$S(k) = \begin{bmatrix} 0 & \dots & n & \dots & N-1 \\ e^{-j2\pi 0n/N} & \dots & 1 \\ \vdots & & \vdots \\ e^{-j2\pi kn/N} & \dots & 1 \\ \vdots & & \vdots \\ e^{-j2\pi (N-1)n/N} & \dots & 1 \end{bmatrix} \begin{bmatrix} s(0) \\ s(1) \\ \vdots \\ s(N-1) \end{bmatrix}$$

$$k \begin{pmatrix} 0 \\ 1 \\ 2 \end{pmatrix} [0 \ 1 \ 2]^n =$$