

as in Exercise 6.1. The twiddle constants are the same as in Exercise 6.1. Note that the twiddle constant W is multiplied with the second term only (not with the first).

Stage 1

$x(0) = \dots = x(3) = 1$

$x(4) = \dots = x(7) = 0$

$N = 8$, four Twiddles.

$W^0 = 1$
 $W^1 = e^{-j\frac{2\pi}{8}} = 0.707 - j0.707j$
 $W^2 = e^{-j\frac{4\pi}{8}} = -j$
 $W^3 = e^{-j\frac{6\pi}{8}} = -0.707 - j0.707j$

$x(0) + W^0x(4) = 1 + 0 = 1 \rightarrow x'(0)$
 $x(0) - W^0x(4) = 1 - 0 = 1 \rightarrow x'(4)$
 $x(2) + W^0x(6) = 1 + 0 = 1 \rightarrow x'(2)$
 $x(2) - W^0x(6) = 1 - 0 = 1 \rightarrow x'(6)$
 $x(1) + W^0x(5) = 1 + 0 = 1 \rightarrow x'(1)$
 $x(1) - W^0x(5) = 1 - 0 = 1 \rightarrow x'(5)$
 $x(3) + W^0x(7) = 1 + 0 = 1 \rightarrow x'(3)$
 $x(3) - W^0x(7) = 1 - 0 = 1 \rightarrow x'(7)$

odd

$W^0 = e^{-j\frac{2\pi}{8} \cdot 0} = 1$
 $W^1 = e^{-j\frac{2\pi}{8} \cdot 1} = 0.707 - j0.707j$
 $W^2 = e^{-j\frac{2\pi}{8} \cdot 2} = -j$
 $W^3 = e^{-j\frac{2\pi}{8} \cdot 3} = -0.707 - j0.707j$
 $W^4 = e^{-j\frac{2\pi}{8} \cdot 4} = -1$
 $W^5 = e^{-j\frac{2\pi}{8} \cdot 5} = -0.707 + j0.707j$
 $W^6 = e^{-j\frac{2\pi}{8} \cdot 6} = j$
 $W^7 = e^{-j\frac{2\pi}{8} \cdot 7} = 0.707 + j0.707j$

where the sequence x' 's represents the intermediate output after the first iteration and becomes the input to the subsequent stage.

Stage 2

$x'(0) + W^0x'(2) = 1 + 1 = 2 \rightarrow x''(0)$
 $x'(4) + W^2x'(6) = 1 + (-j) = 1 - j \rightarrow x''(4)$
 $x'(0) - W^0x'(2) = 1 - 1 = 0 \rightarrow x''(2)$
 $x'(4) - W^2x'(6) = 1 - (-j) = 1 + j \rightarrow x''(6)$
 $x'(1) + W^0x'(3) = 1 + 1 = 2 \rightarrow x''(1)$
 $x'(5) + W^2x'(7) = 1 + (-j)(1) = 1 - j \rightarrow x''(5)$
 $x'(1) - W^0x'(3) = 1 - 1 = 0 \rightarrow x''(3)$
 $x'(5) - W^2x'(7) = 1 - (-j)(1) = 1 + j \rightarrow x''(7)$

where the intermediate second-stage output sequence x'' 's becomes the input sequence to the final stage.

Stage 3

$x''(0) + W^0x''(2) + W^0[x'(1) + W^0x'(3)]$
 $X(0) = x''(0) + W^0x''(1) = 4$
 $X(1) = x''(4) + W^1x''(5) = 1 - j2.414$
 $X(2) = x''(2) + W^2x''(3) = 0$
 $X(3) = x''(6) + W^3x''(7) = 1 - j0.414$
 $X(4) = x''(0) - W^0x''(1) = 0$
 $X(5) = x''(4) - W^1x''(5) = 1 + j0.414$
 $X(6) = x''(2) - W^2x''(3) = 0$
 $X(7) = x''(6) - W^3x''(7) = 1 + j2.414$

which is the same output sequence as found in Exercise 6.1.

$X(n) = \sum_{k=0}^{N-1} x(k) W^{nk} = x(0)W^0 + x(1)W^1 + x(2)W^2 + x(3)W^3 + \dots + x(7)W^7$

6.5 BIT

A bit-reversed bit-stream are swapped at the address $X(1)$. Since $X(3)$ are for the input $N = 8$ and the twiddle constants for several stages.

6.6 DEV

A radix-4 FFT algorithm on in-frequency inputs and of stages. four stage summation

Let $n = n$ Cons. resp

which represents