FFT, Decimation in frequency (8-point sequence)

Based on

For N-point sequence :-

$$x[K] = \sum_{n=0}^{N-1} x[n]\, e^{\frac{-j2\pi K n}{N}}$$

$$x[K] = \sum_{n=0}^{N-1} x[n]\, W_N^{nK} \qquad K = 0, 1, \ldots N-1$$

Here we are using 8-point sequence.

$$\therefore x[K] = \sum_{n=0}^{7} x[n]\, e^{\frac{-j2\pi K n}{8}} = \{x(0), x(1), \ldots x[7]\}$$

$$\therefore W_N^K = e^{-j\left(\frac{2\pi}{N}\right)K} \quad \boxed{N=8} \quad \boxed{2^\gamma \; \gamma=3}$$ $\therefore$ we going to have 3 stages.

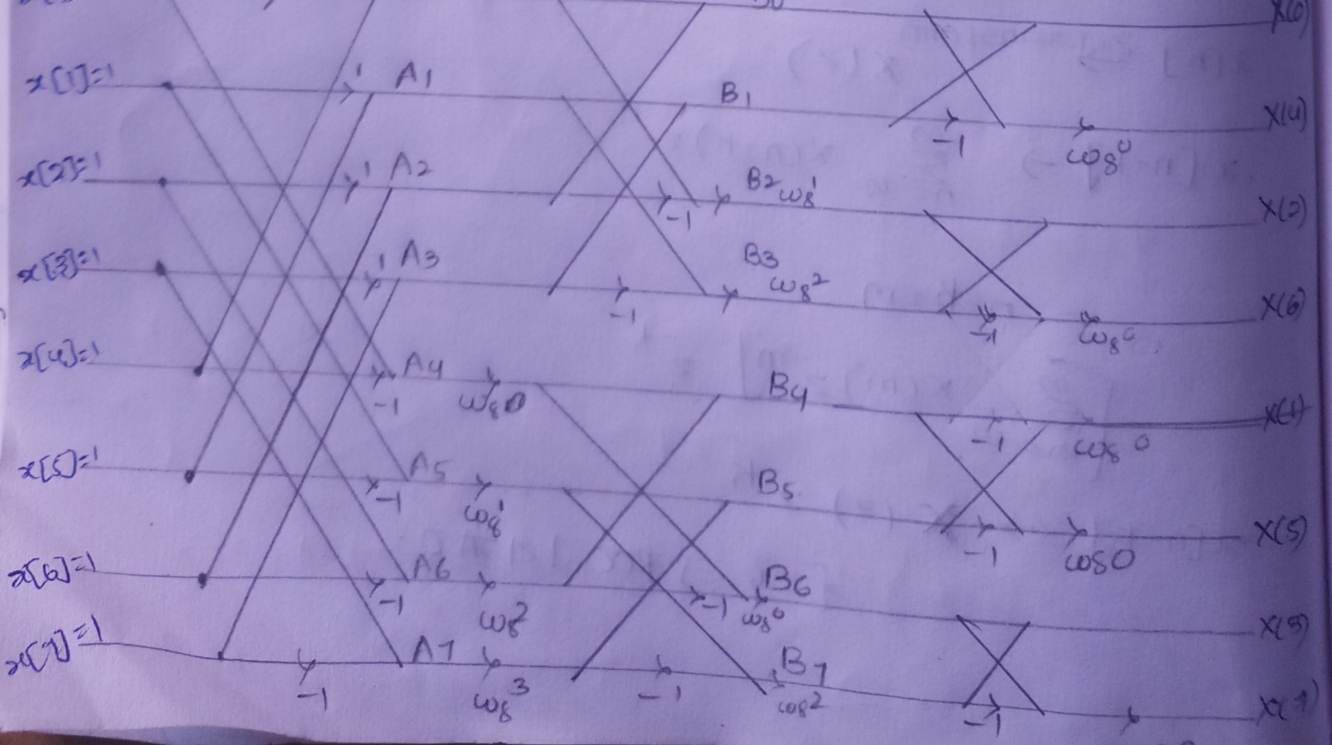
$$W_8^0 = e^{-j\left(\frac{2\pi}{8}\right)(0)} = 1$$

$$W_8^1 = e^{-j\left(\frac{2\pi}{8}\right)(1)} = e^{-j\frac{\pi}{4}} = 0.707 - j0.707$$

$$W_8^2 = e^{-j\left(\frac{2\pi}{8}\right)(2)} = -j$$

$$W_8^3 = e^{-j\left(\frac{2\pi}{8}\right)(3)} = e^{-j\left(\frac{3\pi}{4}\right)} = 0.707 - j0.707.$$

Butterfly diagram $\quad x[n] = \begin{cases} 1 & ; 0 \le n < 7 \\ 0 & ; \text{Otherwise.} \end{cases}$



o/p of 1st stage

$A_0 = x(0) + x(4) = 2$

$A_1 = x(1) + x(5) = 2$

~~$A_2 = A_3 x(7) = 2$~~

$A_2 = x(2) + x(6) = 2$

$A_3 = A(3) + x(7) = 2$

$A_4 = [x(0) - x(4)] \omega_8^0 = 0$

$A_5 = [x(2) - x(6)] \omega_8^1 = 0$

$A_6 = [x(2) - x(6)] \omega_8^2 = 0$

$A_7 = [x(3) - x(7)] \omega_8^3 = 0$

IInd stage

$B_0 = A_0 + A_2 = 4$

$B_1 = A_1 + A_3 = 4$

$B_2 = [A_0 - A_2] \times \omega_8^0 = 0$

$B_3 = [A_1 - A_3] \omega_8^2 = 0$

$B_4 = A_4 + A_6 = 0$

$B_5 = A_5 + A_7 = 0$

$B_6 = [A_4 - A_6] \omega_8^0 = 0$

$B_7 = [A_5 - A_7) \omega_8^2 = 0$

IIIrd stage

$X(0) = B_0 + B_1 = 8$

$X(4) = [B_0 - B_1] \omega_8^0 = 0$

$X(2) = B_2 + B_3 = 0$

$X(6) = (B_2 - B_3) = 0$

$X(1) = [B_4 + B_5) = 0$

$X(5) = [B_4 - B_5) \omega_8^0 = 0$

$X(3) = B_6 + B_7 = 0$

$X[7] = [B_6 - B_7] \omega_8^0 = 0$

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