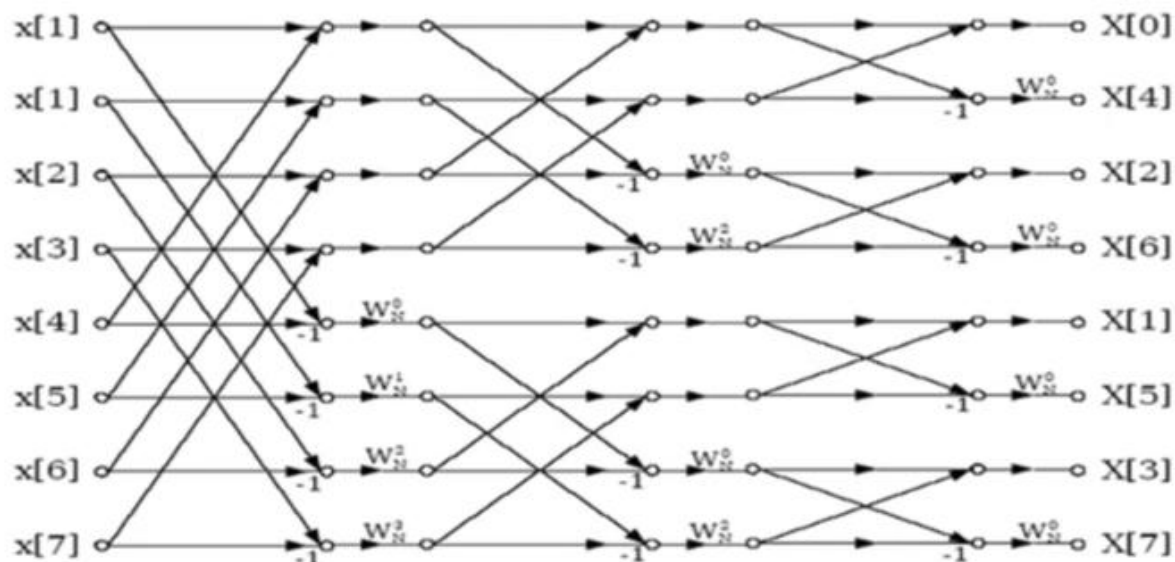# DIF-FFT-for N=8
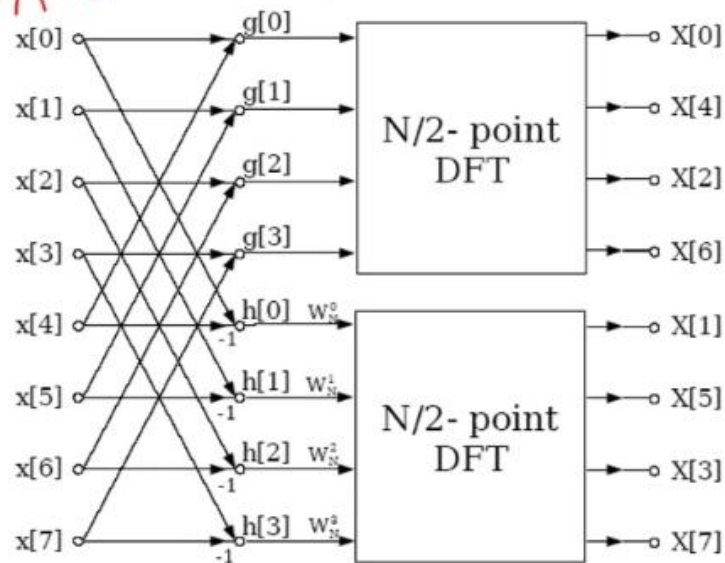

$\frac{N}{2} \log_2 N$ complex multiplies

$N \log_2 N$ complex adds

$W_N^0, W_N^{\frac{N}{8}}, W_N^{\frac{N}{4}}, W_N^{\frac{N}{8}}, W_N^{\frac{3N}{8}}$

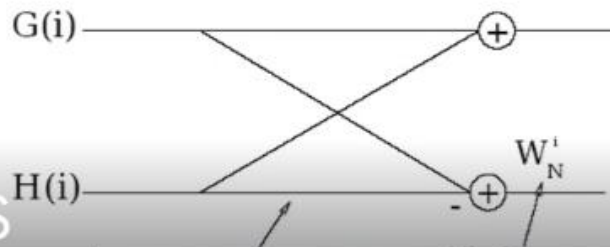$2N \log_2 N - 7N + 12$ real multiplies

$3N \log_2 N - 3N + 4$ real additions

DIF-FFT Contd...

$$2\left(\frac{N}{2}\right)^2 + N = \frac{N^2}{2} + \frac{N}{2} \text{ complex multiplies}$$

$$2\frac{N}{2}\left(\frac{N}{2}-1\right) + N = \frac{N^2}{2} \text{ complex additions}$$

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DIF -FFT

$$X(2r) = \sum_{n=0}^{N-1} x(n) W_N^{2rn}$$

$$= \sum_{n=0}^{\frac{N}{2}-1} x(n) W_N^{2rn} + \sum_{n=0}^{\frac{N}{2}-1} x\left(n + \frac{N}{2}\right) W_N^{2r\left(n+\frac{N}{2}\right)}$$

$$= \sum_{n=0}^{\frac{N}{2}-1} x(n) W_N^{2rn} + \sum_{n=0}^{\frac{N}{2}-1} x\left(n + \frac{N}{2}\right) W_N^{2rn} 1$$

$$= \sum_{n=0}^{\frac{N}{2}-1} \left(x(n) + x\left(n + \frac{N}{2}\right)\right) W_{\frac{N}{2}}^{rn}$$

$$= \text{DFT}_{\frac{N}{2}} \left[x(n) + x\left(n + \frac{N}{2}\right)\right]$$

$$X(2r+1) = \sum_{n=0}^{N-1} x(n) W_N^{(2r+1)n}$$

$$= \sum_{n=0}^{\frac{N}{2}-1} \left(x(n) + W_N^{\frac{N}{2}} x\left(n + \frac{N}{2}\right)\right) W_N^{(2r+1)n}$$

$$= \sum_{n=0}^{\frac{N}{2}-1} \left(\left(x(n) - x\left(n + \frac{N}{2}\right)\right) W_N^n\right) W_{\frac{N}{2}}^{rn}$$

$$= \text{DFT}_{\frac{N}{2}} \left[\left(x(n) - x\left(n + \frac{N}{2}\right)\right) W_N^n\right]$$