4. Ex: $N = 9$, $n_1 = n_2 = 3$

$$X(k) = \sum_{s=0}^{2} W_9^{sk} \sum_{r=0}^{2} x(3r+s) W_3^{rk}$$

$$= W_9^{0} \sum_{r=0}^{2} x(3r) W_3^{rk} + W_9^{k} \sum_{r=0}^{2} x(3r+1) W_3^{rk}$$

$$+ W_9^{2k} \sum_{r=0}^{2} x(3r+2) W_3^{rk}$$

$NR \log_R N$

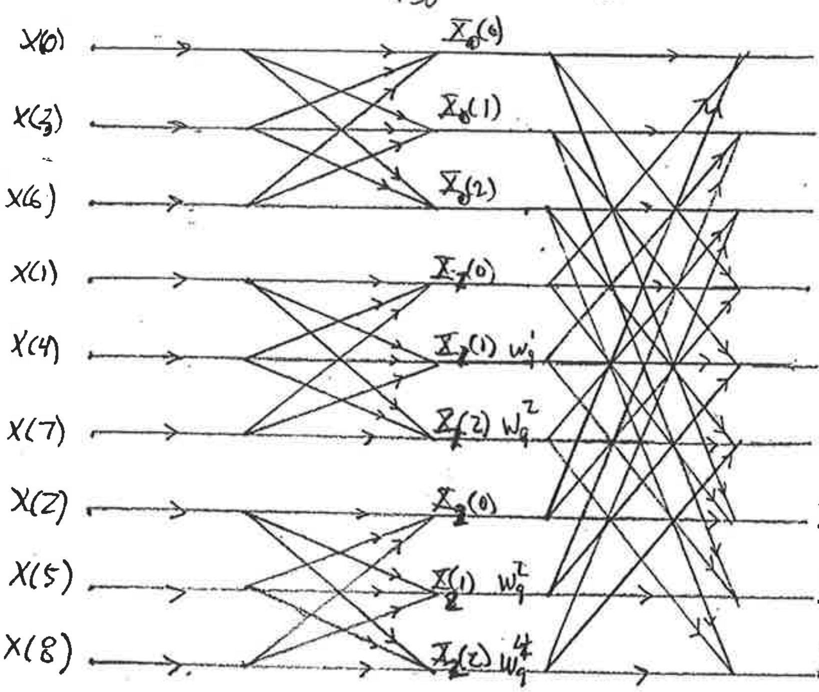
$(R^2 - R)\frac{N}{R} \log_R N$

$\frac{N}{R} \log_R N$

$\frac{9}{3} \times 2$

$3 \times 9 = 27 + 18$

$= 54$



$X(0) = X_0(0) + X_1(0) + X_2(0)$

$X(1) = X_0(1) + W_9^1 X_1(1) + W_9^2 X_2(1)$

$X(2) = X_0(2) + W_9^2 X_1(2) + W_9^4 X_2(2)$

$X(3) = X_0(0) + W_9^3 X_1(0) + W_9^6 X_2(0)$

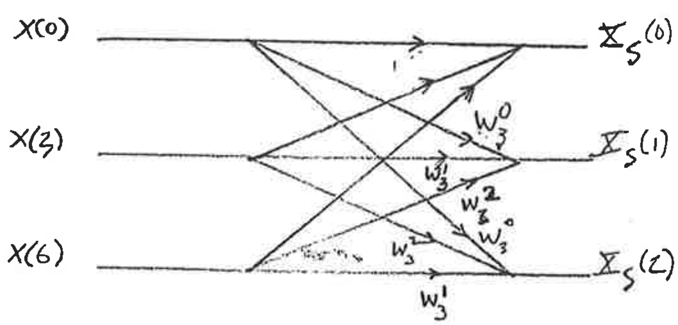
$X(4) = X_0(1) + W_9^4 X_1(1) + W_9^8 X_2(1)$

$X(5) = X_0(2) + W_9^5 X_1(2) + W_9^1 X_2(2)$

$X(6) = X_0(0) + W_9^6 X_1(0) + W_9^3 X_2(0)$

$X(7) = X_0(1) + W_9^7 X_1(1) + W_9^5 X_2(1)$

$X(8) = X_0(2) + W_9^8 X_1(2) + W_9^7 X_2(2)$



9 CMULT / Butterfly
6 CADD

3 Butterflys / stage

54 CMULT → 216 MULT
36 CAdd → 180 ADDS

81 cmult
72 cadd
81×4 = 324 MULT

18.

12
16