

Q.7. We know FFT breaks the array in two parts and then calculate FFT. This is repeated till one element

$$\Rightarrow \text{FFT}(N) = \text{FFT}(N/2) + \lambda \text{FFT}(N/2)$$

where $\lambda = \text{some factor}$

Counting no. of steps in it, additions = $N/2$

multiplications = $N/2$

FFT of $N/2$ two times.

$$\Rightarrow \text{Total steps} = 2 \times \frac{N}{2} + 2T\left(\frac{N}{2}\right)$$

$$T(N) = N + 2 \left(2T\left(\frac{N}{4}\right) + N \right)$$

$$T(N) = 3N + 4 \left(2T\left(\frac{N}{8}\right) + N \right)$$

So we get $\log_2(N)$ such levels with $O(N)$ operation at each step.

$$\Rightarrow \text{Complexity of FFT} = O(\log_2(N))$$

Ref: The Computational Complexity of FFT
by Mathias Lehner

Website (folk.uio.no)