

$$w = e^{-i \frac{2\pi}{N}}$$

$$\sum_k = \sum_{k=0}^N$$

$$\hat{a}_m = \frac{1}{\sqrt{N}} \sum_k a_k w^{mk}$$

$$\hat{b}_m = \frac{1}{\sqrt{N}} \sum_k b_k w^{mk}$$

$$(a+b)_m = \frac{1}{\sqrt{N}} \sum_k a_k b_{m-k}$$

$$\widehat{a+b} = \hat{a} \hat{b}$$

$$\widehat{a+b}_m = \hat{a}_m \hat{b}_m$$

$$L = \widehat{a+b}_m = \frac{1}{\sqrt{N}} \sum_k (a+b)_k w^{mk} = \frac{1}{\sqrt{N}} \sum_k \frac{1}{\sqrt{N}} \sum_j a_j b_{k-j} w^{mk} =$$

$$= \frac{1}{\sqrt{N}} \sum_j \frac{1}{\sqrt{N}} \sum_k a_j b_{k-j} w^{mk} = \frac{1}{\sqrt{N}} \sum_j a_j \frac{1}{\sqrt{N}} \sum_k b_{k-j} w^{mk} = |k-j=m|$$

$$= \frac{1}{\sqrt{N}} \sum_j a_j \frac{1}{\sqrt{N}} \sum_m b_m w^{m(j+m)} = \frac{1}{\sqrt{N}} \sum_j a_j w^{mj} \frac{1}{\sqrt{N}} \sum_m b_m w^{mm} =$$

$$= \hat{a}_m \hat{b}_m = R$$