$x_0(t) = \frac{1}{2}\left[(1+t^2)\ \cos \ldots\right.$

(3) $x_1(n) = \{2,1,2,1\}$ & $x_2(n) = \{1,2,3,4\}$ using DFT & IDFT

$X_4 = W_4 \cdot x_4$

$$\begin{bmatrix} x(0) \\ x(1) \\ x(2) \\ x(3) \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 2 \\ 1 \\ 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 6 \\ 0 \\ 2 \\ 0 \end{bmatrix}$$

$x_2(n)$

$$\begin{bmatrix} X_2(0) \\ X_2(1) \\ X_2(3) \\ X_2(4) \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} = \begin{bmatrix} 10 \\ -2+2j \\ -2 \\ -2-2j \end{bmatrix}$$

$X_1(K) \cdot X_2(K)$

$$= \begin{bmatrix} 6 \times 10 \\ 0 \times -2+j2 \\ 2 \times -2 \\ 0 \times -2-2j \end{bmatrix} = \begin{bmatrix} 60 \\ 0 \\ -4 \\ 0 \end{bmatrix}$$

IDFT

$$\begin{bmatrix} x_1(0) \\ x_1(1) \\ x_1(2) \\ x_1(3) \end{bmatrix} = \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & j & -1 & -j \\ 1 & -1 & 1 & -1 \\ 1 & -j & -1 & j \end{bmatrix} \begin{bmatrix} 60 \\ 0 \\ -4 \\ 0 \end{bmatrix}$$

$$= \frac{1}{4} \begin{bmatrix} 56 \\ 64 \\ 56 \\ 64 \end{bmatrix} = [14, 16, 14, 16]$$

$x(n) = \{2, 1, 2, 1\}$ $\quad h(n) = \{1, 2, 3, 4\}$

$$x(n) \circledast h(n) = \begin{bmatrix} 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 \\ 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$$

$$= \begin{bmatrix} 2+2+6+4 \\ 1+4+3+8 \\ 2+2+6+4 \\ 1+4+3+8 \end{bmatrix} = \begin{bmatrix} 14 \\ 16 \\ 14 \\ 16 \end{bmatrix}$$

$y(k) = \{14, 16, 14, 16\}$

IDFT

(2)

$x(0) = 9$

$x(1) = 6.928 \angle -1.57$

$x(2) = 0$

$x(3) = 4.58 \angle -2.28$

$x(4) = 0$

$x(5) = 6.92 \angle 1.57$

(o(t)
$= \frac{1}{2}[(1+t^2)\cos(10t)] - (1+t^2)\cos(1\ldots$
$= 0$
n) $= 1 - u(n)$

(i) Circular time shift property

$$DFT\{x(n-m)_N\} = X(k)\, e^{-j\frac{2\pi k m}{N}}$$

(ii) statement - 1
proof - 2

Linearity

$$DFT\{x_1(n)\} = X_1(k) \;\&\; DFT\{x_2(n)\} = X_2(k)$$

$$DFT\{a_1 x_1(n) + a_2 x_2(n)\} = a_1 X_1(n) + a_2 X_2(n)$$

statement - 1
proof - 2

DFT of $x(n) = \{1, 2, 0, 1\}$

$$\begin{bmatrix} X_1(0) \\ X_1(1) \\ X_1(2) \\ X_1(3) \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 0 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1+2+0+1 \\ 1-2j+0+j \\ 1-2+0-1 \\ 1+2j+0-j \end{bmatrix} = \begin{bmatrix} 4 \\ 1-j \\ -2 \\ 1+j \end{bmatrix}$$

$$X(k) = \{4, 1-j, -2, 1+j\}$$

$x_0(t) = \frac{1}{2}\left[(1+t^2)\cos(\ldots)\right]$

(5) $x(n) = \{1, 4, 0, 3, 7, 4, -7, -7, -1, 3, 4, 4\}$ $h(n) = \{$

$N = 5$, $N = M + L - 1 \Rightarrow 5 = 2 + L - 1 \Rightarrow L = 4$

$x_1(n) = \{1, 4, 0, 3, 0\}$ $h(n) = \{1, 2, 0, 0, 0\}$

$x_2(n) = \{7, 4, -7, 7, 0\}$ $h(n) = \{1, 2, 0, 0, 0\}$

$x_3(n) = \{-1, 3, 4, 4, 0\}$ $h(n) = \{1, 2, 0, 0, 0\}$

$$y_1(n) = \begin{bmatrix} 1 & 0 & 3 & 0 & 4 \\ 4 & 1 & 0 & 3 & 0 \\ 0 & 4 & 1 & 0 & 3 \\ 3 & 0 & 4 & 1 & 0 \\ 0 & 3 & 0 & 4 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 1+0+0 \\ 4+2 \\ 0+8 \\ 3+0 \\ 0+6 \end{bmatrix} = \begin{bmatrix} 1 \\ 6 \\ 8 \\ 3 \\ 6 \end{bmatrix}$$

$$y_2(n) = \begin{bmatrix} 7 & 0 & -7 & -7 & 4 \\ 4 & +7 & 0 & -7 & -7 \\ -7 & 4 & 7 & 0 & -7 \\ -7 & -7 & 4 & 7 & 0 \\ 0 & -7 & -7 & 4 & 7 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 7+0 \\ 4+14 \\ -7+8 \\ -7-14 \\ 0-14 \end{bmatrix} = \begin{bmatrix} 7 \\ 18 \\ 1 \\ -21 \\ -14 \end{bmatrix}$$

$$y_3(n) = \begin{bmatrix} -1 & 0 & 4 & 4 & 3 \\ 3 & -1 & 0 & 4 & 4 \\ 4 & 3 & -1 & 0 & 4 \\ 4 & 4 & 3 & -1 & 0 \\ 0 & 4 & 4 & 3 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} -1+0 \\ 3-2 \\ 4+6 \\ 4+8 \\ 0+8 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \\ 10 \\ 12 \\ 8 \end{bmatrix}$$

$y_1(n) =$ 1 6 8 3 6

7 18 1 -21 -14

-1 1

$y(n) = \{1, 6, 8, 3, 13, 18, 1, -21, -15, 1, 1$

$x(t) = \frac{1}{2}\left[(1+t^2)\cos(10t)\right] - \ldots$

(6) $x(n) = \{2, 3, 1, 1\}$ $h(n) = \{1, 3, 5, 3\}$

$X(k) = \{2W_4^0 + 3W_4^k + 1W_4^{2k} + 1W_4^{3k}\}$

$H(k) = \{1W_4^0 + 3W_4^k + 5W_4^{2k} + 3W_4^{3k}\}$

$Y(k) = X(k) \cdot H(k)$

$= \{2 + 3W_4^k + W_4^{2k} + W_4^{3k}\}\{1 + 3W_4^k + 5W_4^{2k} + 3W_4^{3k}$

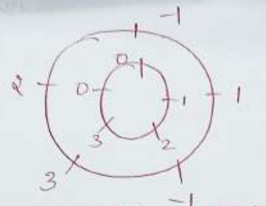
$= 2 + 6W_4^k + 10W_4^{2k} + 6W_4^{3k} + 3W_4^k + 9W_4^{2k} + 15W_4^{3k} +$

$W_4^{2k} + 3W_4^{3k} + 5W_4^{4k} + 3W_4^{5k} + W_4^{3k} + 3W_4^{4k} + 5W_4^{5k} +$

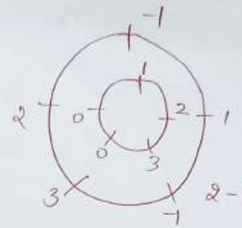
$= 2 + 9W_4^k + 20W_4^{2k} + 26W_4^{3k} + 17W_4^{4k} + 8W_4^{5k} + 3$

$= \{2, 9, 20, 26, 17, 8, 3\}$

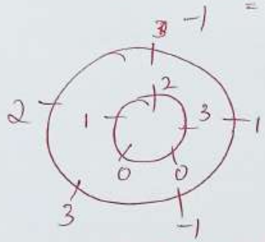
(a)



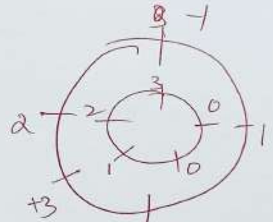
$= 1+0+0+9-1-2 = 8$



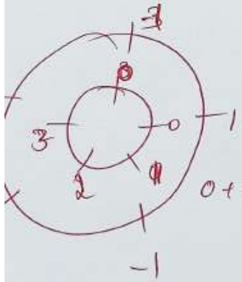
$2-1+0+\ldots$



$3-2+2+0+0 = 3$



$0+3+4-3+0 = +2$



$0+0+6+6-1 = 11$

$\{8, 2, 3, 7, 11\}$

Commutative property of convolution Sum

$y(k) = h_1(k) * h_2(k) = h_2(k) *$

Proof