

ECE- 314

SIGNALS AND SYSTEMS

Summer 2013

LTI Systems

- ✓ DT LTI Systems: The Convolution Sum
 $h[-k+n]$ generation, explanation of indices of
'n', MATLAB example

SIGNALS AND SYSTEMS

- DT LTI System: Convolution Sum

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

- Example:

$x[n]$				$h[n]$				
-1	1/2	1	-1/2	0	1/2	1	-1/2	1/2
-1	0	1	2	-1	0	1	2	3
$x[k]$				$h[-k]$				
-1	1/2	1	-1/2	1/2	-1/2	1	1/2	0
-1	0	1	2	-3	-2	-1	0	1

$n = ?$

$h[-k+n]$					$x[k]$			
1/2	-1/2	1	1/2	0	-1	1/2	1	-1/2
-5	-4	-3	-2	-1	-1	0	1	2

← Looks like $n = 2$

Is $n = 2$?

$h[n-k]$: Shift + scaling

$h[k+2]$					→	$h[-k+2]$				
0	1/2	1	-1/2	1/2		1/2	-1/2	1	1/2	0
-3	-2	-1	0	1		-1	0	1	2	3

✗

Actually, $n = -2$:

$h[n-k]$: Shift + scaling

$h[k-2]$					→	$h[-k-2]$				
0	1/2	1	-1/2	1/2		1/2	-1/2	1	1/2	0
1	2	3	4	5		-5	-4	-3	-2	-1

✓

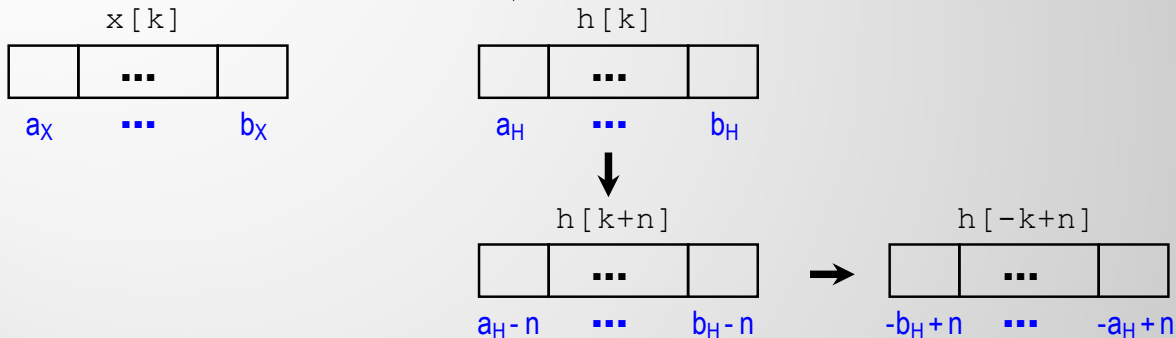
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Example:

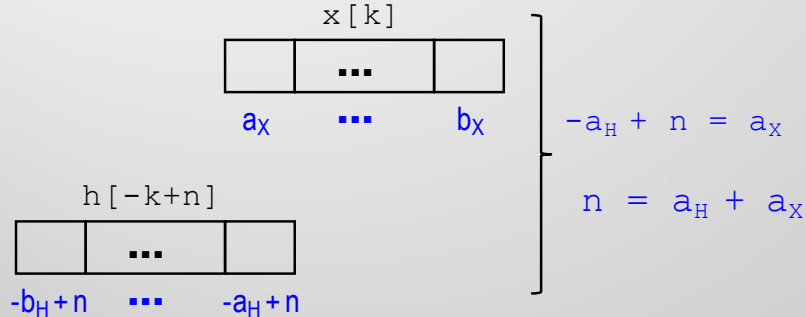
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SIGNALS AND SYSTEMS

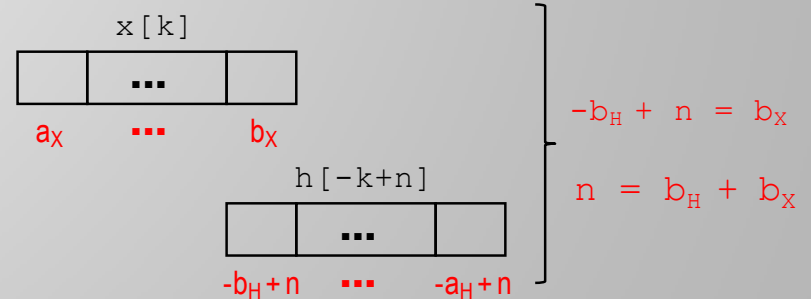
- General Case: (useful for MATLAB convolution)



Initial 'n':



Final 'n':



Length of $x[n]$: $L_X = b_X - a_X + 1$

Length of $h[n]$: $L_H = b_H - a_H + 1$

$$\text{Length of } y[n]: L_Y = b_X + b_H - a_H - a_X + 1 = L_X + L_H - 1$$