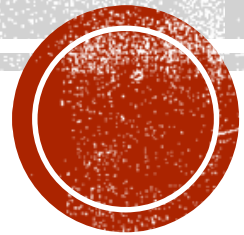
CONVOLUTION



EQUATION OF CONVOLUTION

- **Convolution** is a mathematical operation on two functions (*f* and *g*)
- It produces a third function
- That is typically viewed as a modified version of one of the original functions
- Equation of convolution is as fallows

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

EQUATION OF CONVOLUTION

- Here to calculate y[n] if we open the equation we will get
  1. $Y[0]=\sum_{k=-\infty}^{\infty} x[k] * h[-k\ ]$
  2. $Y[1]=\sum_{k=-\infty}^{\infty} x[k] * h[1-k\ ]$
- nth value of output is sum of product of x with n times shifted versions of h

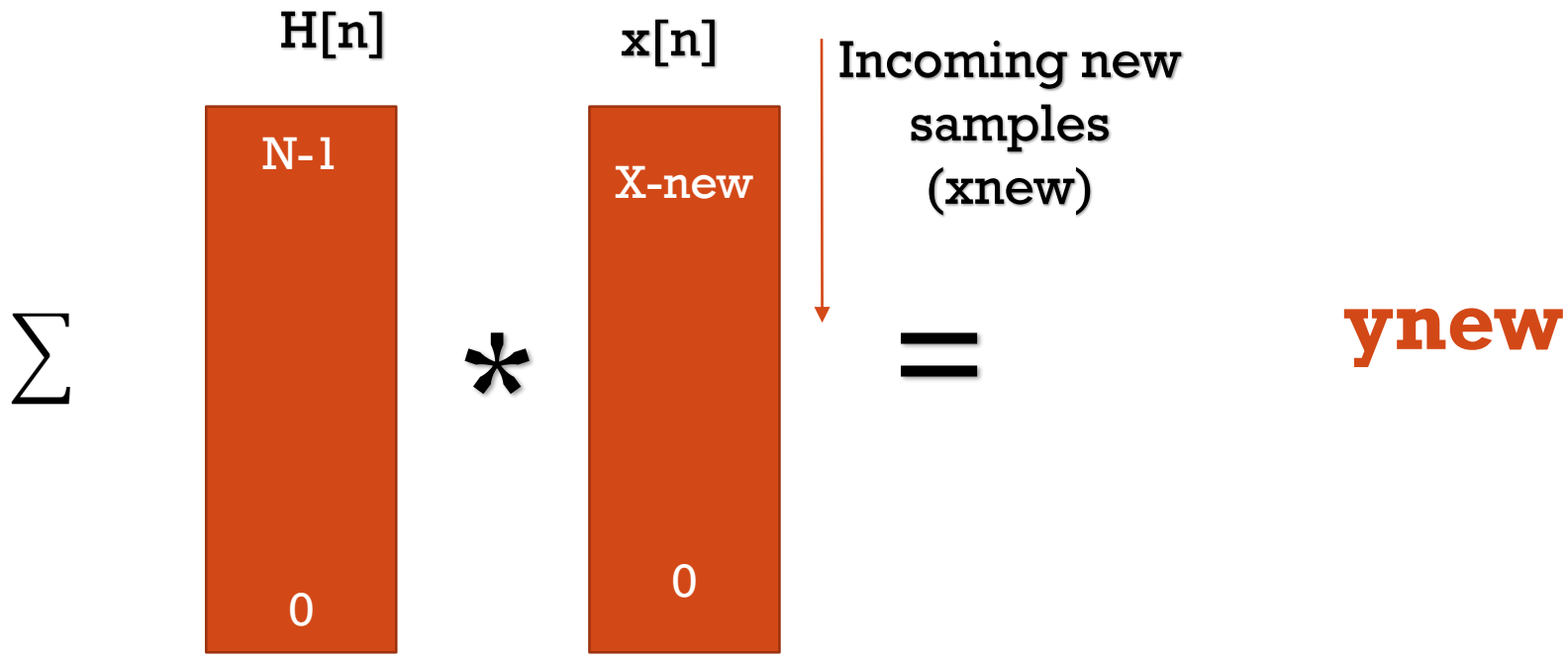
RUNTIME CONVOLUTION

- In runtime systems input signal is continuously coming, and for every new input sample we have to calculate the output.
- For runtime systems better version of the equation is

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

- h[n] will remains static and x[n] will change and shift for every new value of x[n].

RUN TIME CONVOLUTION



TASK-1

- Write code to create function that performs convolution for every new sample of x[n],and gives the output sample.

where h[n]=[0 0.1 0.2 0.4 0.2 0.1 0]

- Call this function for x[n]=n for n=0:15 and calculate y[n]

STEPS

- In order to perform convolution in a pseudo real time environment following steps are recommended:
  - Create a buffer of equal length (N) as the system (in this case 7)
    - Because at any time a maximum overlap between the signal and the system can be of length N
  - Initialize it with zeros
    - In case of partial overlap the non overlapping portion must be considered as zero
  - Now for each value of x
    - Place the latest received value of x in buffer such that all the older values of buffer are shifted by one place and the latest value of x is placed in the space left by the shifting operation.
    - Point to point multiply the values of buffer with the system coefficients $mult = buff .* h;$
    - Sum up the resultant matrix $val = \sum_{i=1}^{N} mult(i)$
    - "Val" is the required value (for a single step of convolution)

TASK-2

- Load signal "**sumsin**" from MATLAB repository (***load filename***)
- Convolve the signal with the following systems separately
  a) h1[n] = [0.1067 0.0336 0.0381 0.0423 0.0463 0.0498 0.0529 0.0554 0.0572 0.0583 0.0585 0.0583 0.0572 0.0554 0.0529 0.0498 0.0463 0.0423 0.0381 0.0336 0.1067]
  b) h2[n] = [-0.1460 0.1248 -0.1611 0.0048 -0.0474 -0.0876 0.0006 -0.1079 -0.1602 0.2275 0.5319 0.2275 -0.1602 -0.1079 0.0006 -0.0876 -0.0474 0.0048 -0.1611 0.1248 -0.1460]
  c) h3[n] = [-0.0024 -0.0110 0.0162 -0.0076 -0.0195 0.0465 -0.0385 -0.0292 0.1442 -0.2546 0.3002 -0.2546 0.1442 -0.0292 -0.0385 0.0465 -0.0195 -0.0076 0.0162 -0.0110 -0.0024]
- ***Comment*** on the behavior of the systems by comparing the input and the output signals