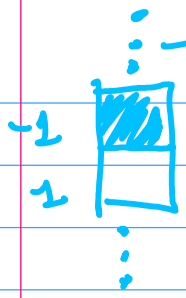
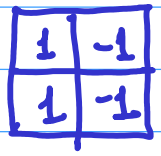
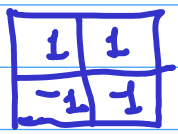


→ other weights ≈ 0 (negligible)

2-D:

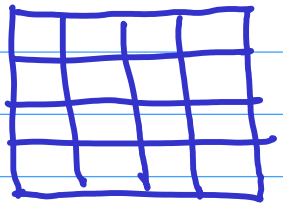


Captures a "vertical" edge



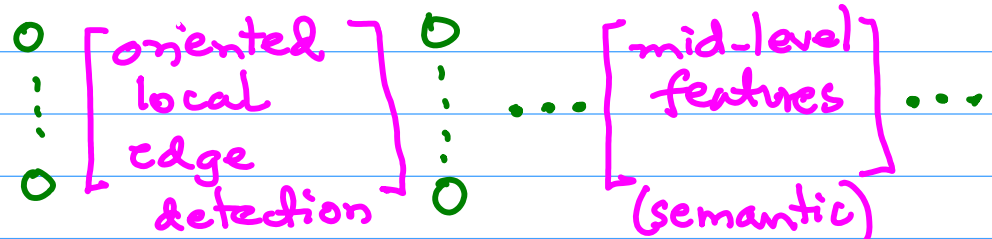
captures a "horizontal" edge

larger neighbourhood



capture edges in different orientations.

Interpretation: (deep networks)



input layer

↓

first layer of connections

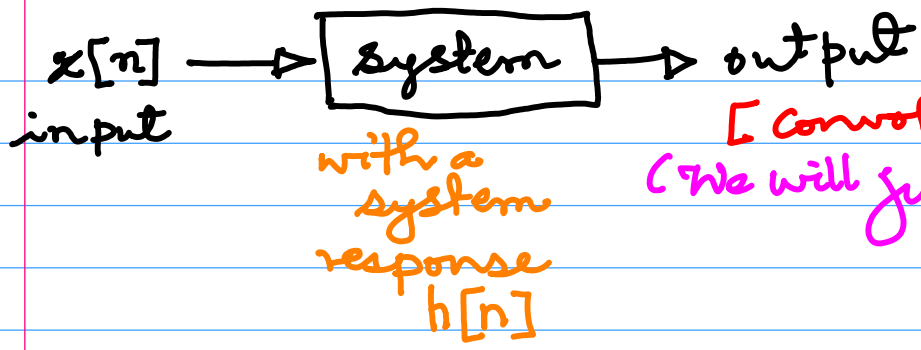
↓

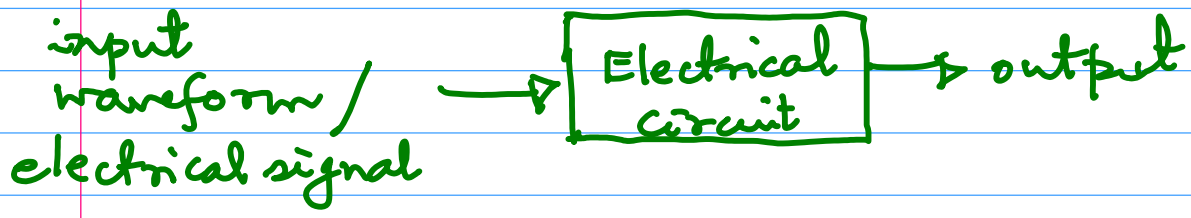
also corresponds to the action in V1/V2 of the visual cortex

[high level features]

e.g., image of a cat/dog

⇒ [1) simple derivative features
2) only 'local', not global]



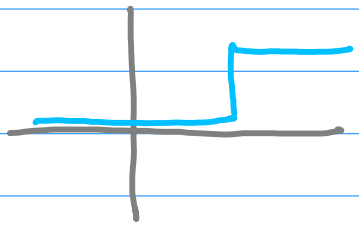


(pothole)

or

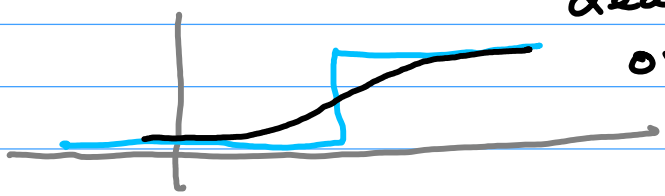
(unit step function/ extreme case of a sigmoid)

smoothing agent/ smoothing filter / Low-pass filter



'damping'

good suspension



dead-beat / overdamped system

(On the other hand, for a chronometer: a time-keeping device, we want an underdamped system)

LSI SYSTEMS (LINEAR SHIFT INVARIANT) SYSTEMS

Approximation

Electrical: diode/BJT linear region
Mechanical: Mass-spring system
$F = -kx$

↳ the nature of the output is the same, just shifted in time/space
e.g., weighing scales with a tray to keep objects

Why are people obsessed with LSI systems?

* Many practical systems can be approximated by LSI systems

(EE specific: analysis
— LSI permit an equivalent freq domain Λ
— complex exponentials/sinusoids are eigenfunctions of LSI systems)

What is linearity? [— Additivity — Homogeneity

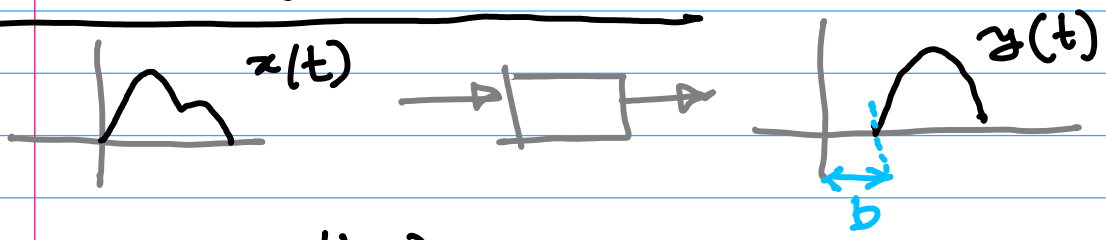
$x_1[n] \longrightarrow y_1[n]$
$x_2[n] \longrightarrow y_2[n]$

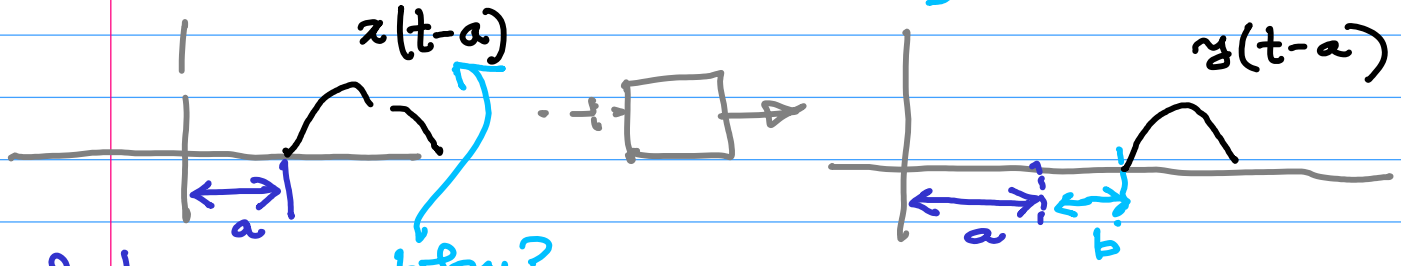
Additivity ⇒ $x_1[n] + x_2[n] \longrightarrow y_1[n] + y_2[n]$

Homogeneity ⇒ $\propto x_1[n] \longrightarrow \propto y_1[n]$

"Superposition Principle"

What is Shift Invariance?





delay = a

why?
it starts at $t-a=0$ i.e., $t=a$
instead of starting at $t=0$

How do we 'characterise' a system?

can be constructed out of different classes of

e.g.; electronic components
- vacuum tubes
- transistors

e.g., mechanical components (time measurement)
- pendulum
- flywheel

we need a "standardisation of the equivalence"

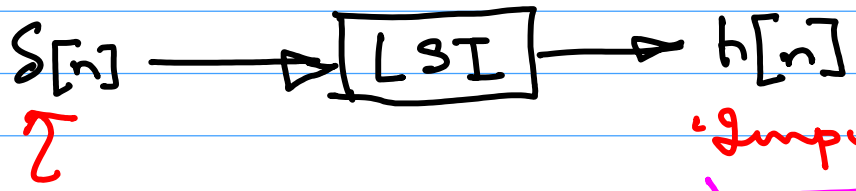
"standard" input → [system] → output

e.g., monitor (CRT / LCD / LED / Plasma)
input [switching on]
characterisation: how quickly does it respond

This output is a waveform which "characterises" the system irrespective of the exact internal hardware construction (as a black box)

→ This allows us to treat a system (electrical/mechanical) as a waveform itself

→ The name of the EE course "Signals and Systems"



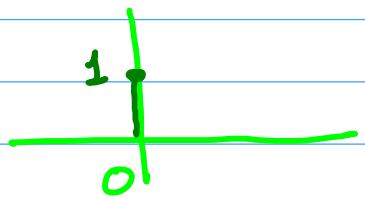
Impulse (Kronecker Delta / 'bar') — This is a standard input

'Impulse Response' is the characterisation of the system

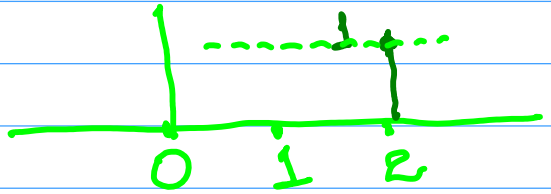
Civil Engg example: Bridge: (Suspension bridge / ... /)

input: perturbation

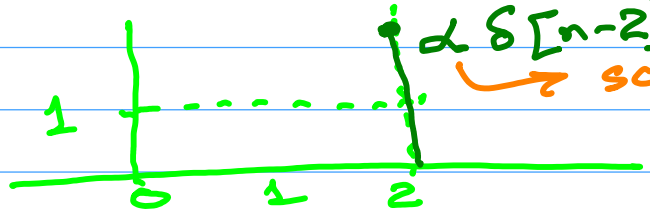
output: vibration response

① 

$\delta[n] \triangleq 1$, at $n=0$ (origin)
0, otherwise

② 

$\delta[n-2] = 1$, at $(n-2)=0$
$\Rightarrow n=2$
$= 0$, otherwise

③ 

→ scaling constant → we can call it $x[2]$