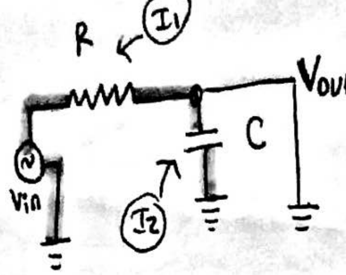

modelling "trickier" functions

→ finite difference method

numerically modeling a low pass circuit

Current : current ~~of~~ through resistor $(I_1) = \frac{V_{in} - V_{out}}{R}$

must be the same at all points ∴ series

current through capacitor $(I_2) = \frac{dQ}{dt} = C\frac{dV}{dt}$

low pass cut-off frequency $= \frac{1}{2\pi RC}$

above: $V_{in} = V_{out}$

below: V_{out} is attenuated and phase-shifted

$$\therefore \quad \boxed{\frac{V_{in} - V_{out}}{R} = C\frac{dV}{dt}} \xrightarrow[\text{analytically}]{\text{somehow solved}} \boxed{V_{out} = V_{in} + Ae^{-t/RC}}$$

this is one way to solve it but modeling is apparently easier.

Finite difference method

a way of doing a derivative with a computer, producing an estimate

$$* \quad \frac{dV}{dt} = \lim_{\Delta t \to 0}\left[\frac{V(t) - V(t-\Delta t)}{\Delta t}\right]$$

$$\frac{V_{in}(t) - V_{out}(t)}{R} = C\,\frac{V_{out}(t) - V_{out}(t-\Delta t)}{\Delta t}$$

solving for $V_{out}(t)$: $\boxed{V_{out}(t) = \dfrac{V_{in}(t) + RC/_{\Delta t}\left(V_{out}(t-\Delta t)\right)}{RC/_{\Delta t} + 1}}$

sine wave
square wave
etc

→ what do I expect for this based on my vin

Δt	Vin	Vout
to		
t+Δt		
⋮		

Sine wave: Vmax, Phase, Freq $\quad V = V_{max} \cdot \sin(\omega t + \phi)$

Vout simulation using Vin as sine wave

1. Pick R, C, Δt
2. get t data points
3. get Vin data points
4. plot and adjust R, C and Δt to make it "siney"
5. ~~p~~ get Vout data points
6. plot Vout