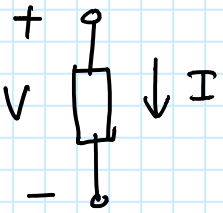
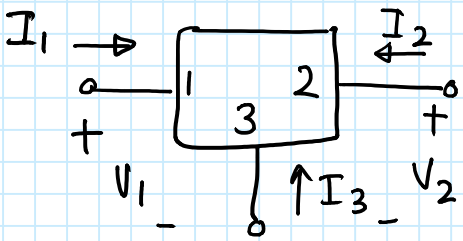
Lecture 2

Today: KCL / KVL, Thevenin & Norton theorems

Electrical elements:



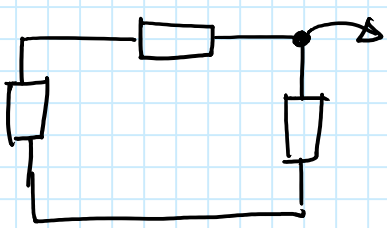
2 terminals



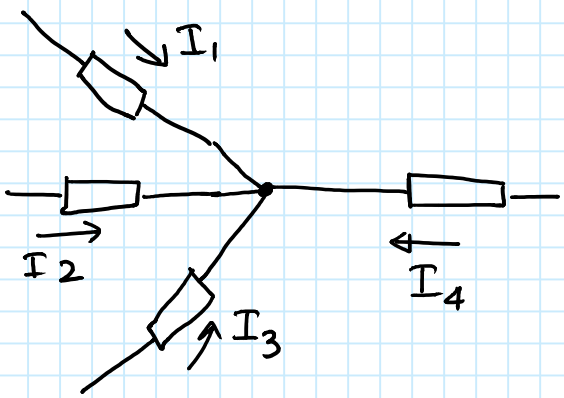
N - terminals

$\Rightarrow$ N−1 currents
N−1 voltages

Electrical Circuit: Interconnection of elements



Node: point of interconnection of 2 or more terminals.



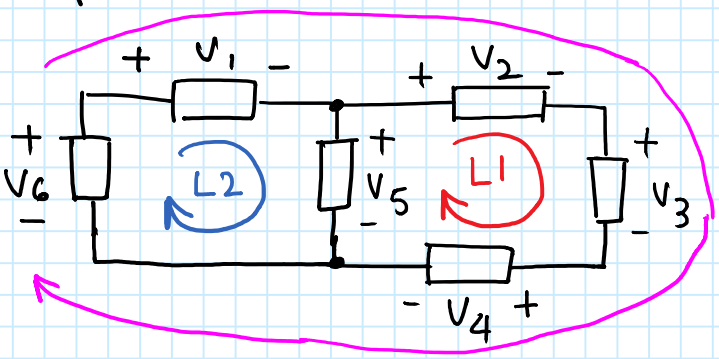
Kirchoff's current law (KCL):

Sum of all currents entering a node is equal to zero

$$\sum I_{\text{entering a node}} = 0$$

$$\equiv \sum I_{\text{leaving a node}} = 0$$

Loop: Closed path formed by elements

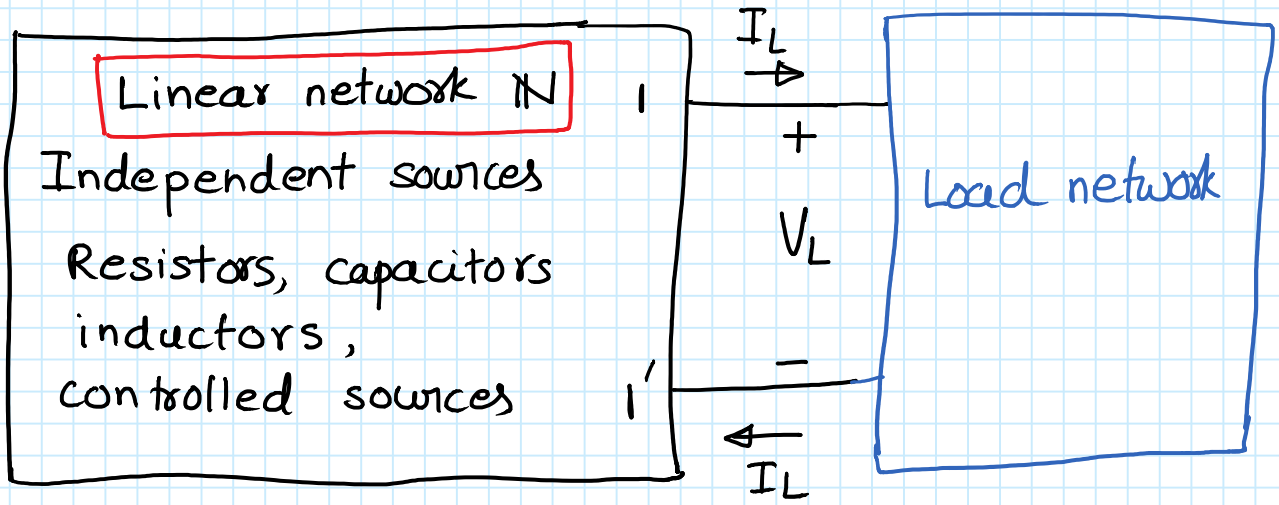


Kirchoff's voltage law (KVL)

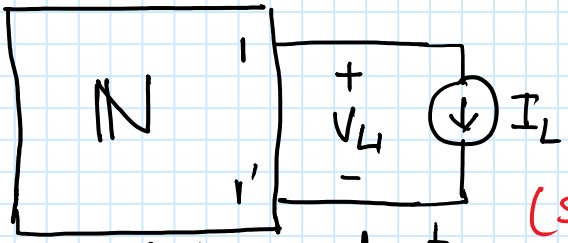
Sum of all voltages around a loop is equal to zero

$$L1: \quad V_2 + V_3 + V_4 - V_5 = 0$$
$$L2: \quad V_1 + V_5 - V_6 = 0$$
$$L3: \quad V_1 + V_2 + V_3 + V_4 - V_6 = 0$$

Thevenin's theorem:

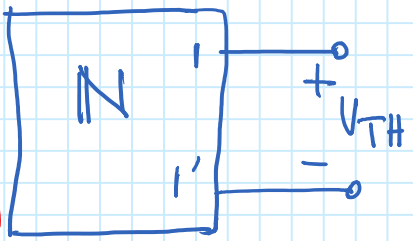


⇒ Want a simplified model of network N



w/ all independent sources set to zero

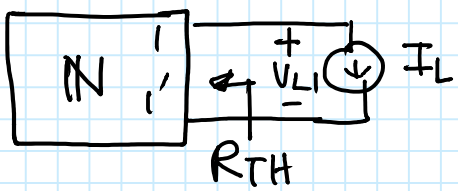
+ (superposition)



w/ $I_L = 0$ (open circuit)

$$V_L = V_{L1} + \underbrace{V_{TH}}_{\text{open circuit voltage}}$$

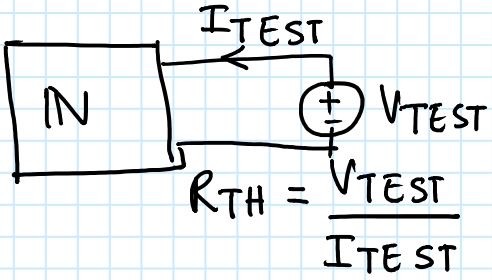
Finding V_{L1}:

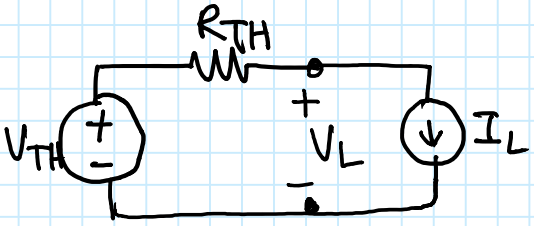


R_{TH} = impedance looking into (1 1') port

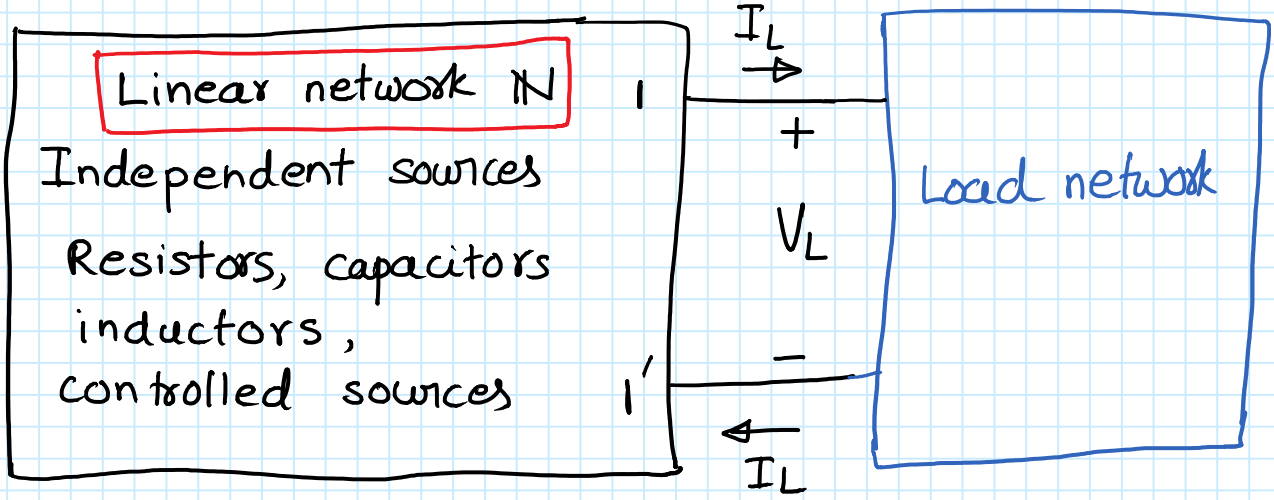
$V_{L1} = -I_L R_{TH}$

$V_L = -I_L R_{TH} + V_{TH}$





Norton's theorem :



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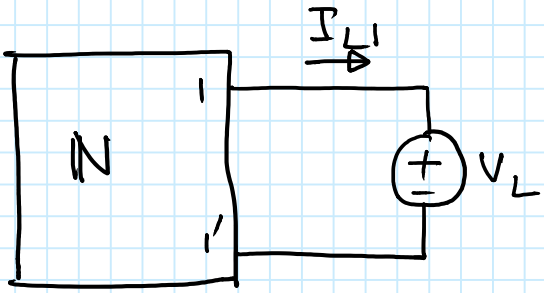

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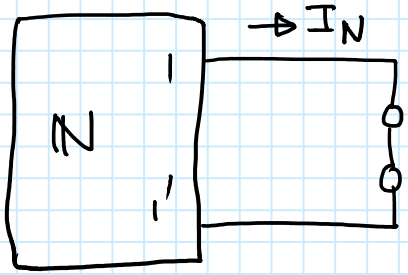
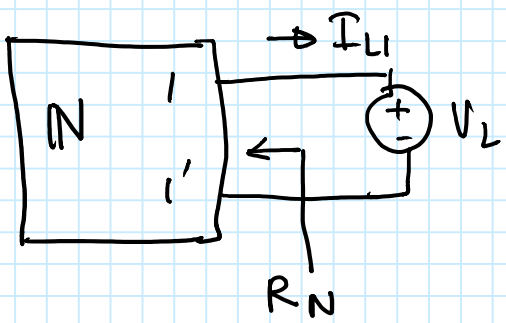


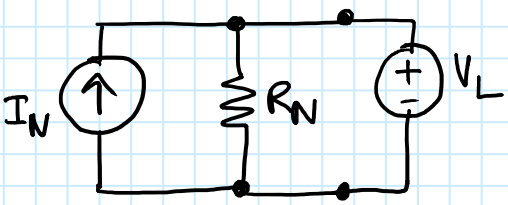
w/ all independent sources set to zero



R_N : impedance looking into (1, 1') port

$$I_{L1} = -\frac{V_L}{R_N}$$

$$I_L = -\frac{V_L}{R_N} + I_N \Rightarrow$$





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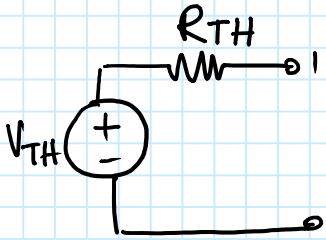

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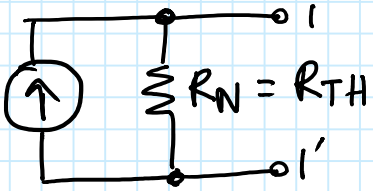

V_{TH} : Open circuit voltage between 1, 1'

I_N : short circuit current between 1, 1'