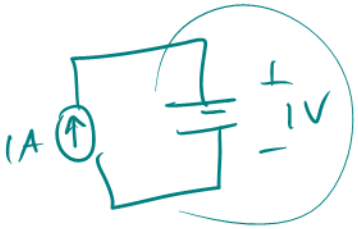
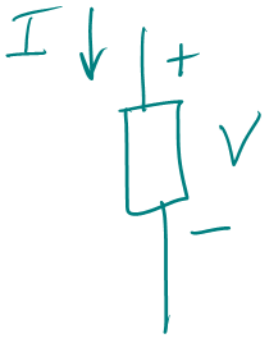
EXAM REVIEW TOPICS:

Lecture 2:

* What is current?
    * Sign convention
    * Positive and negative charge
    * AC versus DC





* What is voltage?
    * How is it related to energy?
    * What is the “ground” potential?
    * What is the physical ground “plane” versus the reference node?

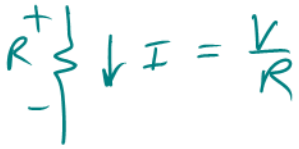
* Power?
    * Passive sign convention
    * Energy

$P = I \cdot V$

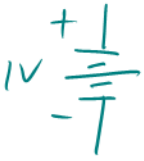
$P \geq 0$

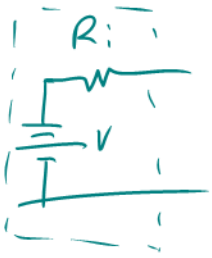
* Components
    * Sign convention of voltage/current
    * Sign convention of power

* Voltage Source
    * Ideal voltage source
    * Real battery
    * Internal resistance/ source resistance



* Ideal switch
    * voltage/current /power





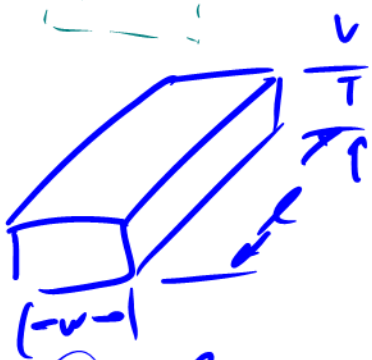
* From Physics: KCL/KVL
* Battery packs (homework)

Lecture 3:

* Conductors
    * Ideal conductors
    * Real conductors
    * Ohm’s law
    * Calculating resistance
    * Conductance
    * Power loss in conductors
    * Strain gauge as an example

$V = I \cdot R$

$I = G \cdot V$



$P = I^2 \cdot R$

$= V^2 \cdot G$

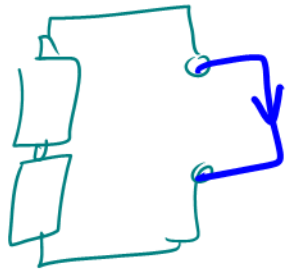
$R = \rho \cdot \frac{\ell}{w \cdot T}$

$G = 1/R$

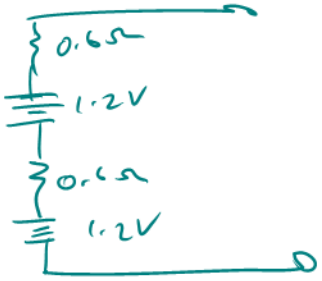
* Resistors as modeling elements
    * Light bulb

$V_{oc} = V_{int} = 1.2V$

$R_i = 0.6\Omega$



$I_{MAX} = ?$

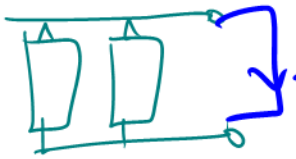


$V'_{oc} = 2.4V$

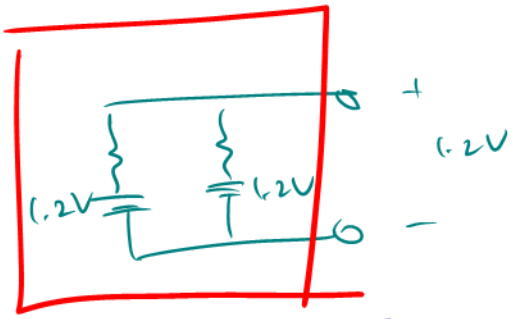
$R'_i = 0.6\Omega + 0.6\Omega$

$= 1.2\Omega$

$I_{max} = \frac{V_{oc}}{R'_i} = 2A$

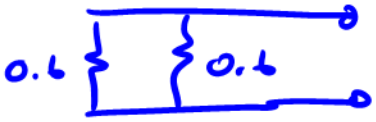


$V'_{oc} = 1.2V$



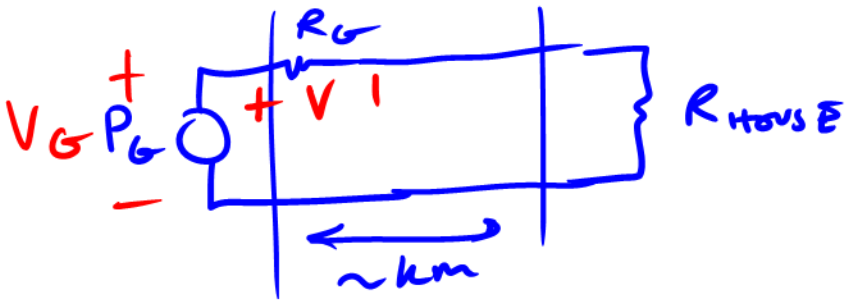
Thevinin :

- ZERO OUT INDEPENDENT SOURCES
- FIND R_{eq} (R_{TH})



$R'_i = 0.3\Omega$

$I_{max} = \frac{V'_{oc}}{R'_i} = \frac{1.2V}{0.3\Omega} = 4A$



* Motor
* Antenna
* Speakers
* Anything passive!

* Energy loss in power delivery
    * High voltage versus high current
    * Need for transformers / AC

$P_{LOSS} \propto I^2 R_G$ V ↑

$P_{LOSS} \propto \frac{V^2}{R_G}$ V ↓ ??

* Resistors
    * Series resistors
    * Parallel resistors

Lecture 4:

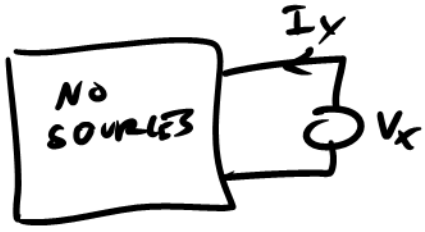
* Current source
* Dependent sources versus independent sources
* Resistive dividers
    * Voltage dividers
    * Current dividers
    * Shorts and opens/Winners and losers

$G = \sum G_i$

* Variable resistors/Pots
* Efficiency of divider circuits

Lecture 5:

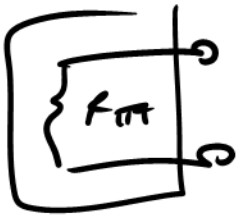
* Nodal analysis
    * counting nodes
    * reference node
    * eliminating nodes
        * super nodes
        * trivial nodes
    * Nodal without dependent sources
    * Nodal with dependent sources
    * Knowns versus unknowns
    * Setting up equations in standard formet (LHS = RHS)
        * LHS = unknowns
        * RHS = knowns

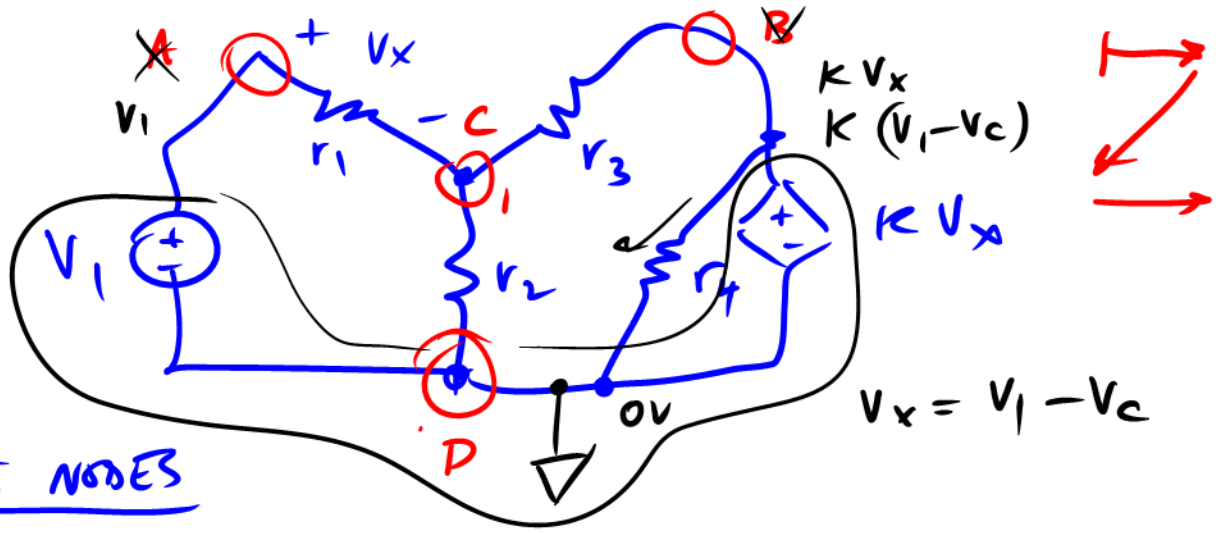


$R_{TH} = \frac{V_X}{I_X}$

Lecture 6:

* Linearity and Superposition
* Thevenin Equivalent
    * Voc and Isc
    * “Req” approach without internal sources





COUNT NODES

A, B, C, D

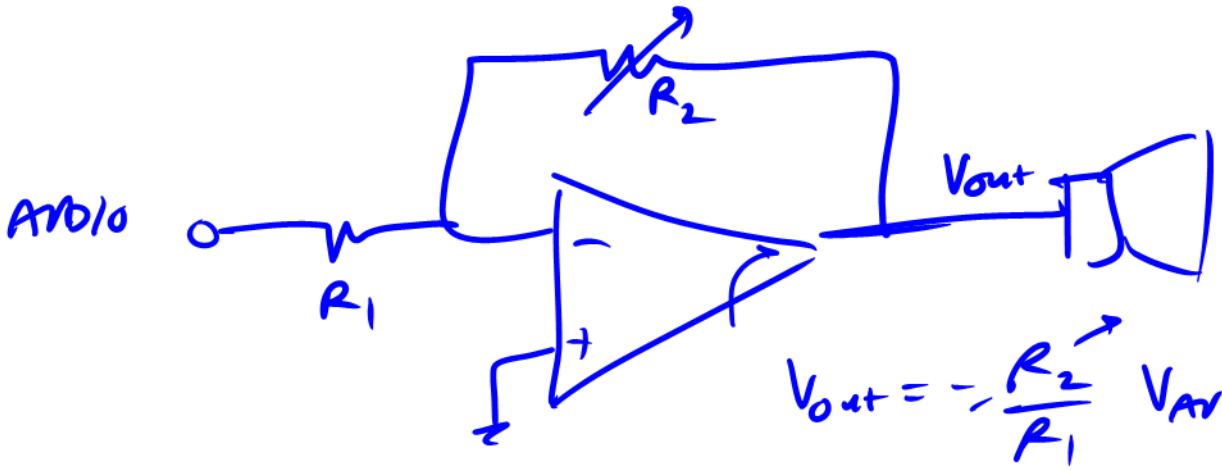
DEFINE A REF NODE : NODE D ⇒ RESULTS IN ELIMINATING 2 OTHER NODES

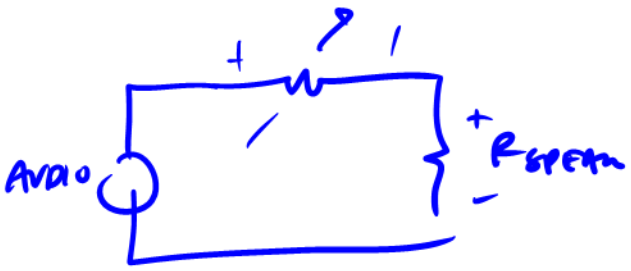
UNK V_C

IDENTIFY SUPER NODES:

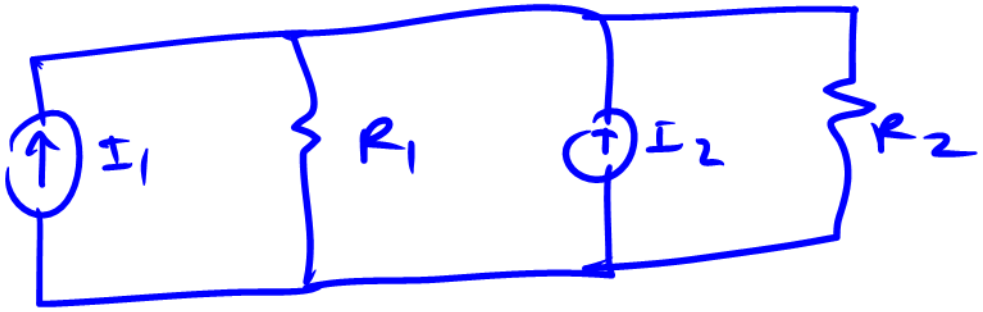
- FLOATING VOLTAGE SOURCE
- GROUP OF CONNECTED VOLTAGE SOURCES

WRITE KCL EQ ⇒ FOR EVERY UNK NODE





$$\eta = \frac{R_{SPEAK}}{R_{SPEAK} + R_{POT}}$$



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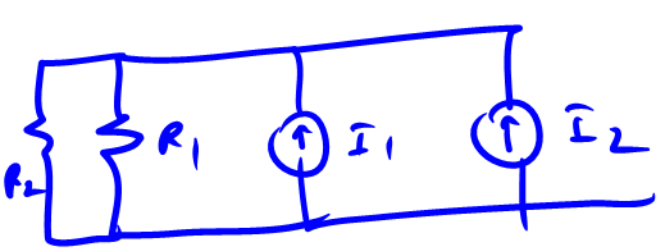
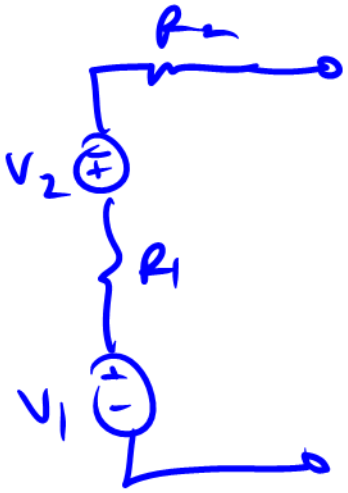


$\equiv R_2 \| R_1$ { $I_1 + I_2$



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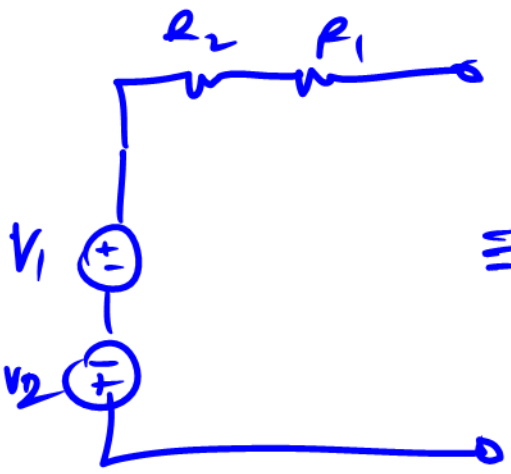
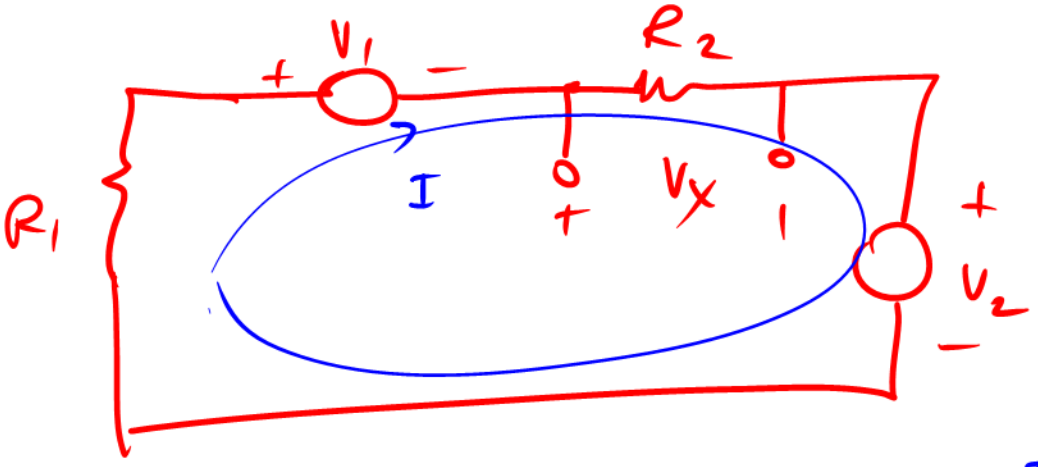


$\equiv$

$V_x = ?$

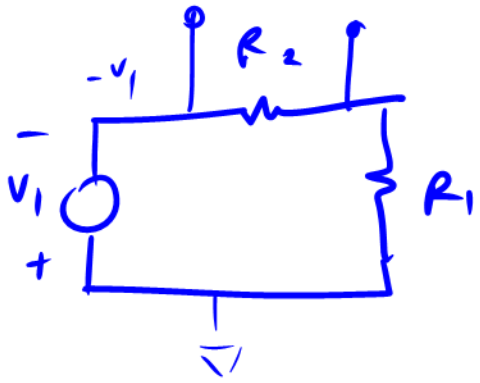


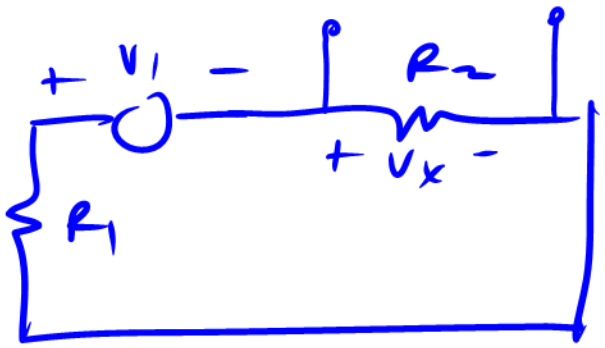
$$V_1 + IR_2 + V_2 + IR_1 = 0 \qquad I = \frac{-(V_1 + V_2)}{R_1 + R_2}$$

$$V_x = IR_2 = -(V_1 + V_2)\frac{R_2}{R_1 + R_2}$$

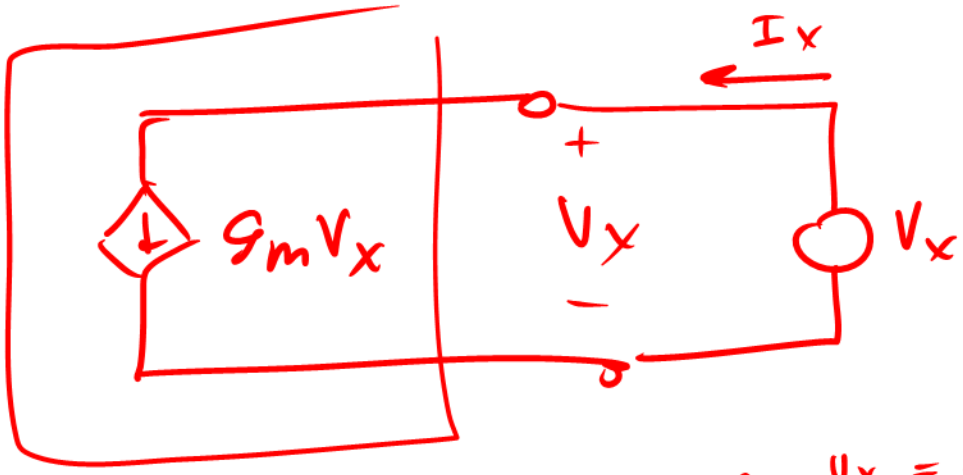
SUPERPOSITION

$V_2 = 0$

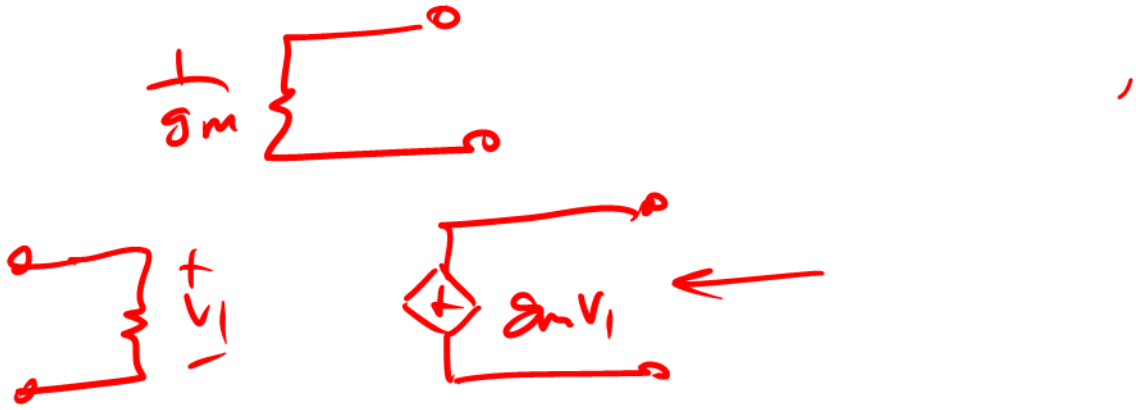


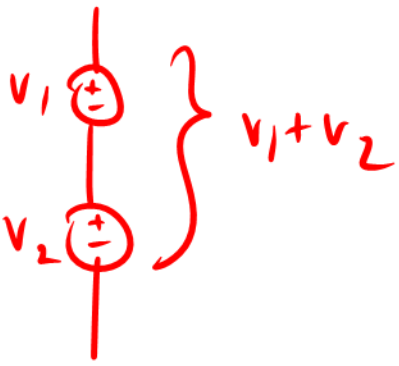


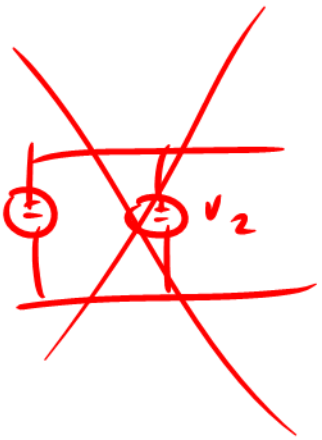
$$V_x = -V_1 \cdot \frac{R_2}{R_1 + R_2}$$



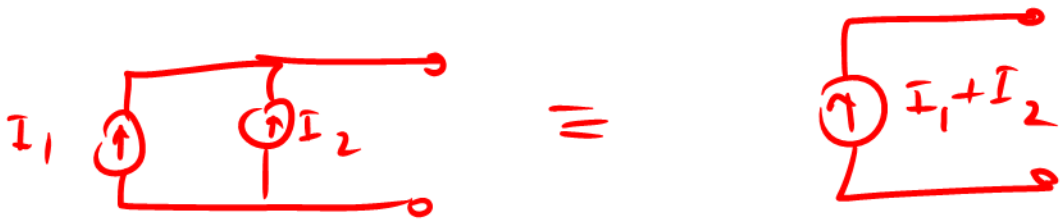
$I_x = g_m V_x \qquad R_{TH} = \frac{V_x}{I_x} = \frac{1}{g_m}$

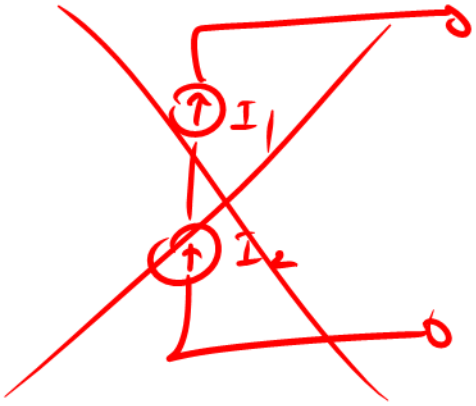






$V_1 \neq V_2$?



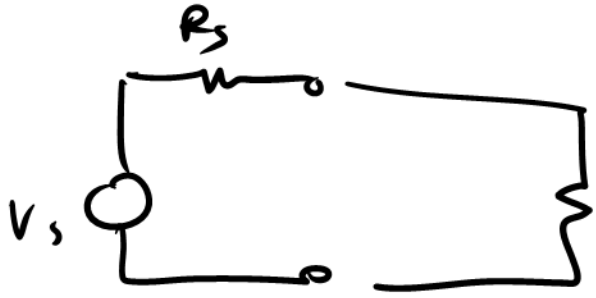


$I_1 \neq I_2$

        * “Req” with independent sources
* Norton Equivalent
* Maximum power transfer theorem
* Wheatstone Bridge (homework)

Lecture 7:

* Amplifiers
        * Terminals
        * Signal pins versus power pins
        * Gain
        * Ideal vs. Real
                * Input R / Output R
        * Equivalent circuit
        * Loading
                * Dividers at input / output
                * Effective gain
                * Cascade
        * Dynamic Range
                * Clipping
* Types: CC, VV, CV, VC
        * Most common is voltage/voltage



$$\eta = \frac{P_L}{P_L + P_S}$$

$$= \frac{I^2 R_L}{I^2 R_S + I^2 R_L}$$

$$= \frac{R_L}{R_S + R_L}$$

$$= \frac{R_S}{2R_S} = 50\%$$

$\Rightarrow$ MAXIMUM POWER EXTRACTED