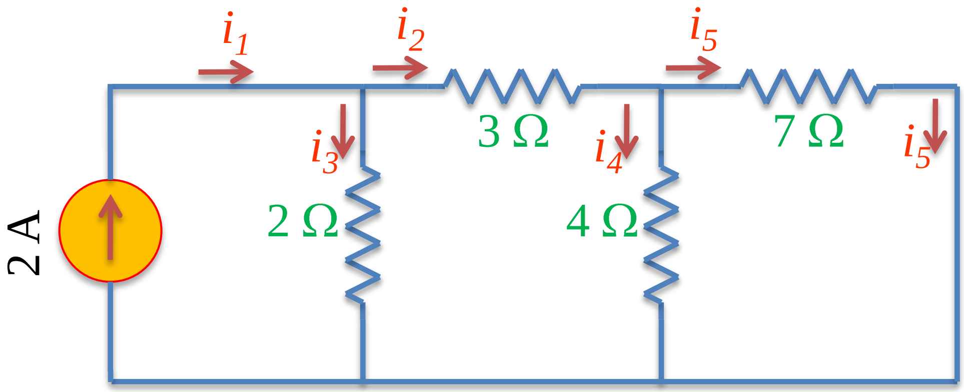
Announcements:

1. Midterm solutions poster
   A. Error needs to be corrected
2. Quiz due next Monday
3. HW due in 2 weeks
   A. Only 1 HW between now and next midterm

EECS 70A: Network Analysis

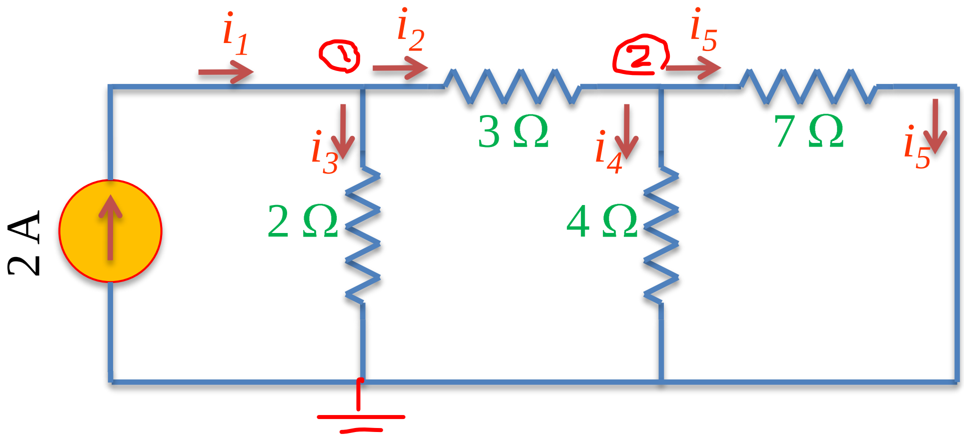
Lecture 5

Nodal analysis example



Computer crashed during lecture so
notes from 2010 example attached.
Replay recording has actual problems as solved in lecture.

Nodal analysis example



① $-i_1 + i_3 + i_2 = 0$

* $2A + \frac{V_1}{2\Omega} + \frac{V_1 - V_2}{3\Omega} = 0$

② $-i_2 + i_4 + i_5 = 0$

** $\frac{V_2 - V_1}{3\Omega} + \frac{V_2}{4\Omega} + \frac{V_2}{7\Omega} = 0$

* → $V_1\left(\frac{1}{2} + \frac{1}{3}\right) - \frac{V_2}{3} = -2 \xrightarrow{\times 6} 5V_1 - 2V_2 = -12$

** → $-\frac{V_1}{3} + V_2\left(\frac{1}{3} + \frac{1}{4} + \frac{1}{7}\right) = 0 \xrightarrow{84} -28V_1 + 61V_2 = 0$

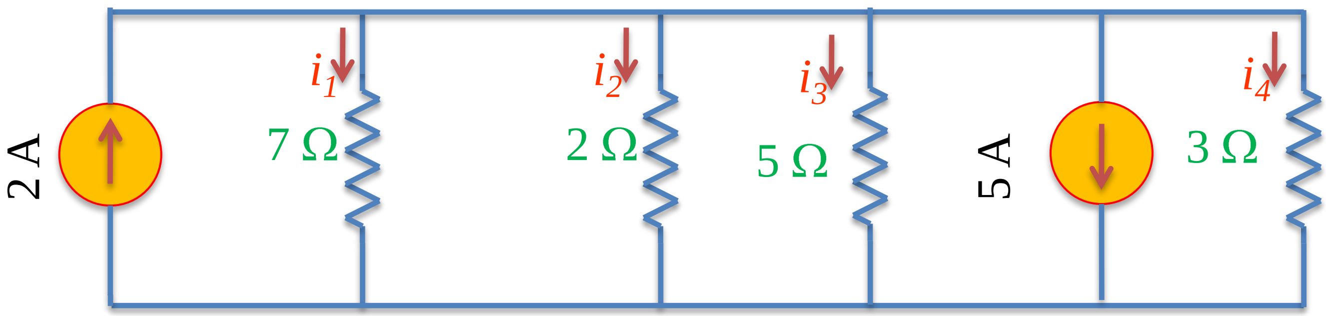
$$V_1 = \frac{\Delta_1}{\Delta} = \frac{\begin{vmatrix} -12 & -2 \\ 0 & 61 \end{vmatrix}}{\begin{vmatrix} 5 & -2 \\ -28 & 61 \end{vmatrix}} = \frac{-12 \times 61 - 0}{5 \times 61 - (-2) \times (-28)} = \frac{732}{249} = 2.93\,V$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{\begin{vmatrix} 5 & -12 \\ -28 & 0 \end{vmatrix}}{249} = \frac{0 - (-12) \times (-28)}{249} = 1.35\,V$$

$i_3 = \frac{2.93\,V}{2\Omega}$

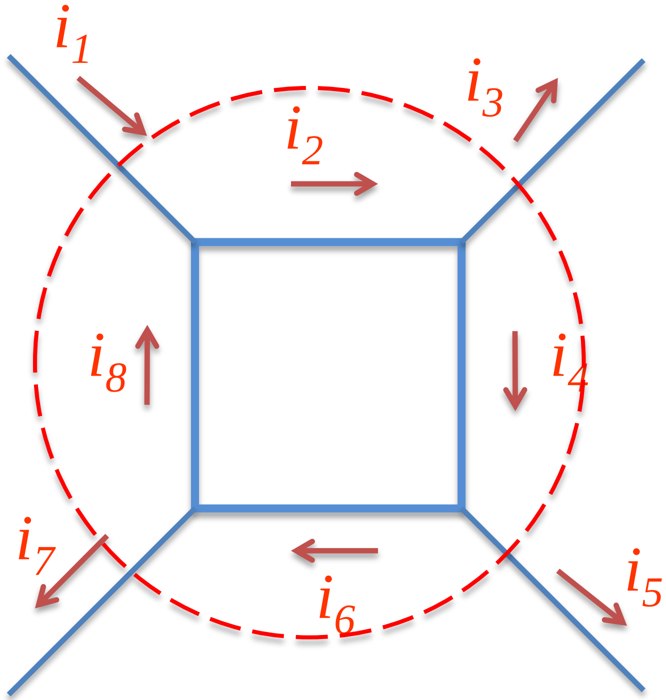
$i_2 = \frac{V_1 - V_2}{3\Omega} = 0.53\,A$

Nodal analysis example



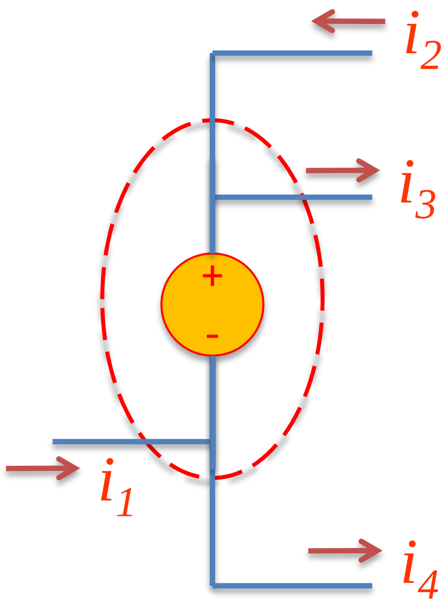
KCL examples

From Lecture 3, Week 2: Find a relationship among i_1,i_2, i_3,$i_{4\ldots}$



"Supernode"

A node with a voltage source in it…

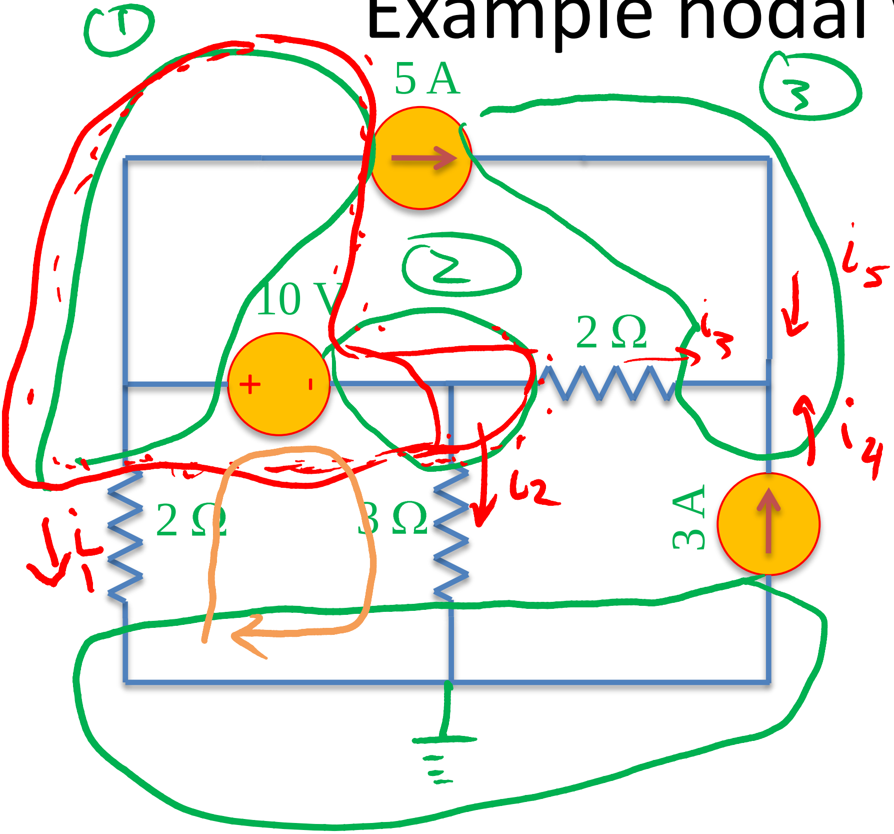


KCL:

Must define a supernode if a voltage source appears when doing nodal analysis…
(unless one end of voltage source connected to reference node)

1. Define a reference node.
2. Label remaining nodes.
3. Apply KCL + ohm to all nodes and supernodes
4. Apply KVL to loop with voltage source

Example nodal w/voltage source



$$i_3 + i_4 + i_5 = 0$$

$$\frac{V_2 - V_3}{2\Omega} + 3A + 5A = 0$$

$$0 = 5A + i_3 + i_2 + i_1 = 0$$

$$= 5A + \frac{V_2 - V_3}{2\Omega} + \frac{V_2 - 0}{3\Omega} + \frac{V_1 - 0}{2\Omega}$$

KVL

$$-(V_1 - 0) + 10V + (V_2 - 0) = 0$$

Announcements:

1. Announcements

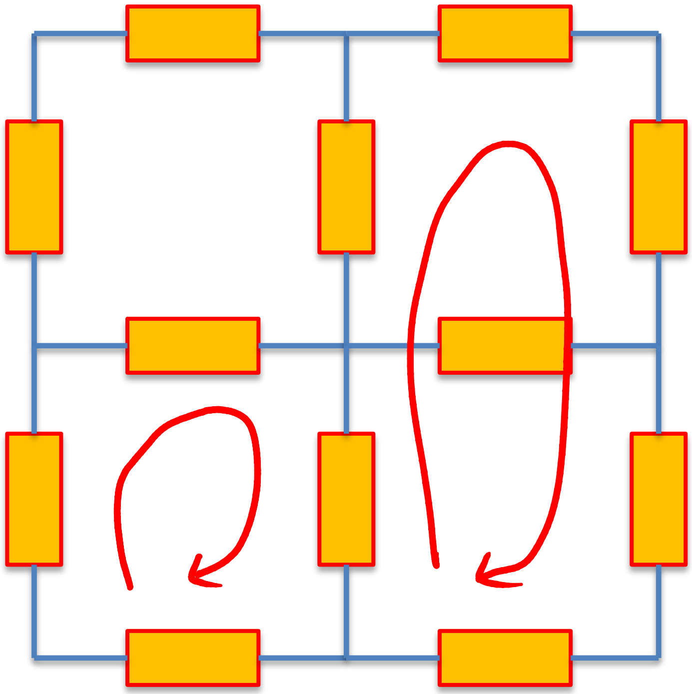
EECS 70A: Network Analysis

Lecture 6

Today’s Agenda

- Review of Nodal Analysis
- Mesh Analysis
  - Introduction
    - What is a Mesh?
    - Mesh Current
  - Method
- Mesh Analysis with Current Source

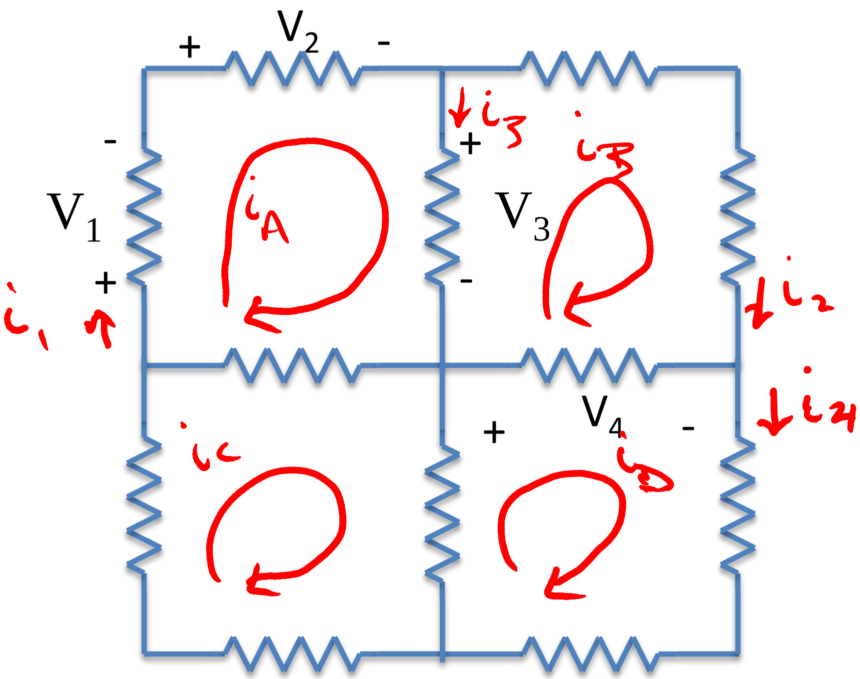
Mesh Analysis-Introduction
What is a Mesh?



- A loop is a closed path with no node passed more than once.
- A mesh is a loop that does not contain any other loops within it.

Mesh Analysis-Introduction

Mesh Current vs. Element Current



- The current through a mesh is known as mesh current.
- Direction of the mesh current is arbitrary-conventionally assumed to be clockwise.
- The current through an element can be the same as mesh current or the subtraction of two mesh currents.

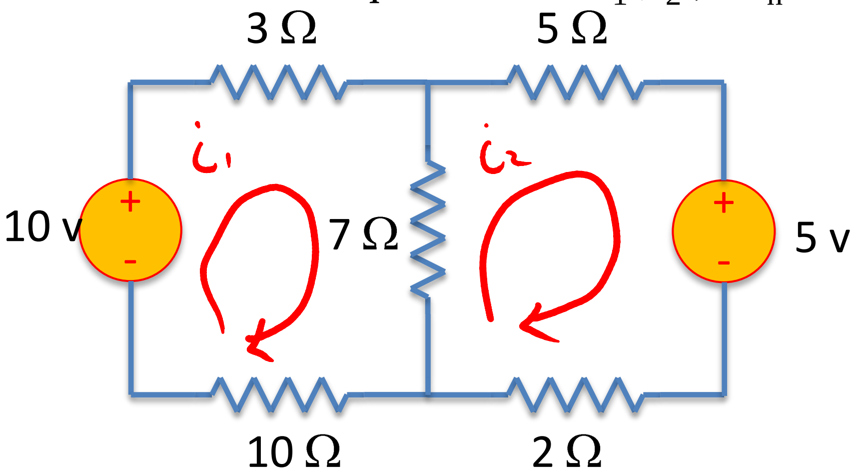
$$i_A = i_1$$

$$i_3 = i_A - i_B$$

$$i_4 = i_D$$

Mesh Analysis-Method

- Assign mesh currents $i_1, i_2, \ldots i_n$
- Apply KVL+ Ohm's law to each mesh
- Solve the equations for $i_1, i_2, \ldots i_n$



$$-10 + (i_1)(3\Omega) + (i_1 - i_2)(7\Omega) + (i_1)(10\Omega) = 0 \quad (*)$$

$$-(i_1 - i_2)(7\Omega) + (i_2)(5\Omega) + 5V + (i_2)(2\Omega) = 0 \quad (**)$$

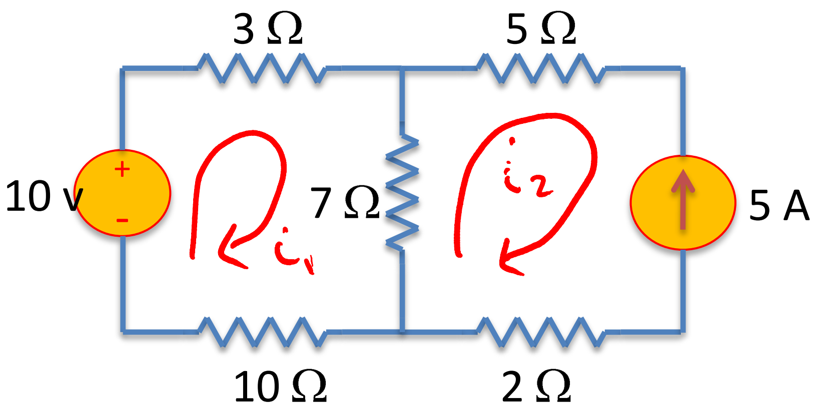
Mesh Analysis with Current Sources

- CASE 1: current source only in one mesh.

LUCK

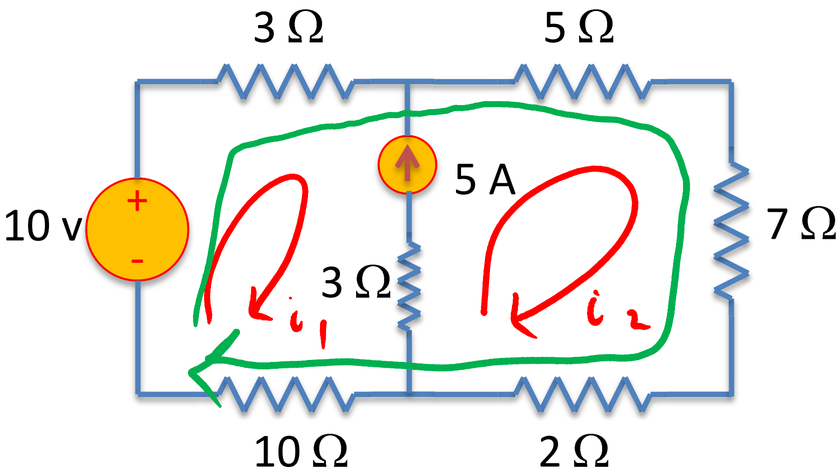
already have the current for that mesh => no need to write KVL for that mesh

$i_2 = -5A$



Mesh Analysis with Current Sources

- CASE 2: current source exits between two meshes. => create a supermesh
  - Apply KVL to the supermesh
  - Apply KCL to the supermesh



$$-10V + (i_1)(3\Omega) + (i_2)(5\Omega) + i_2 7\Omega + i_2 2\Omega + i_1 10\Omega = 0 \quad (*)$$

$$i_1 + 5A = i_2 \quad (*)(*)$$

Mesh Analysis - Example

$$i\,(1\Omega) + (i_1 - i_2)\,2\Omega + 2(i_2 - i_3) = 0 \quad (*)$$

$$(i_2 - i_1)(2\Omega) + i_2\,7\Omega + (i_2 - i_3)\,4\Omega = 0 \quad (**)$$

$$-(2i) + (i_3 - i_2)(4\Omega) - 5V + i_3\,3\Omega = 0 \quad (***)$$

$$i = (i_2 - i_3)$$