Review: Analysis Techniques

- **Nodal Analysis**
- **KVL, KCL**
- **Thevenin's Theorem**

Keys:

- **FIRST know what you're looking for**
- **THEN write simplest equations to get you there**

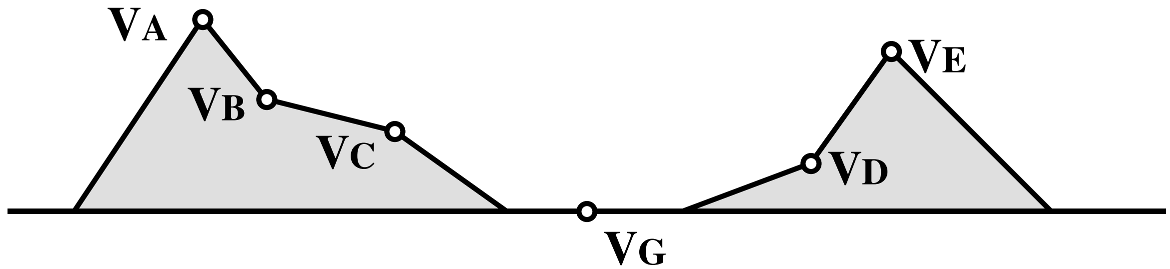
Nodal Analysis

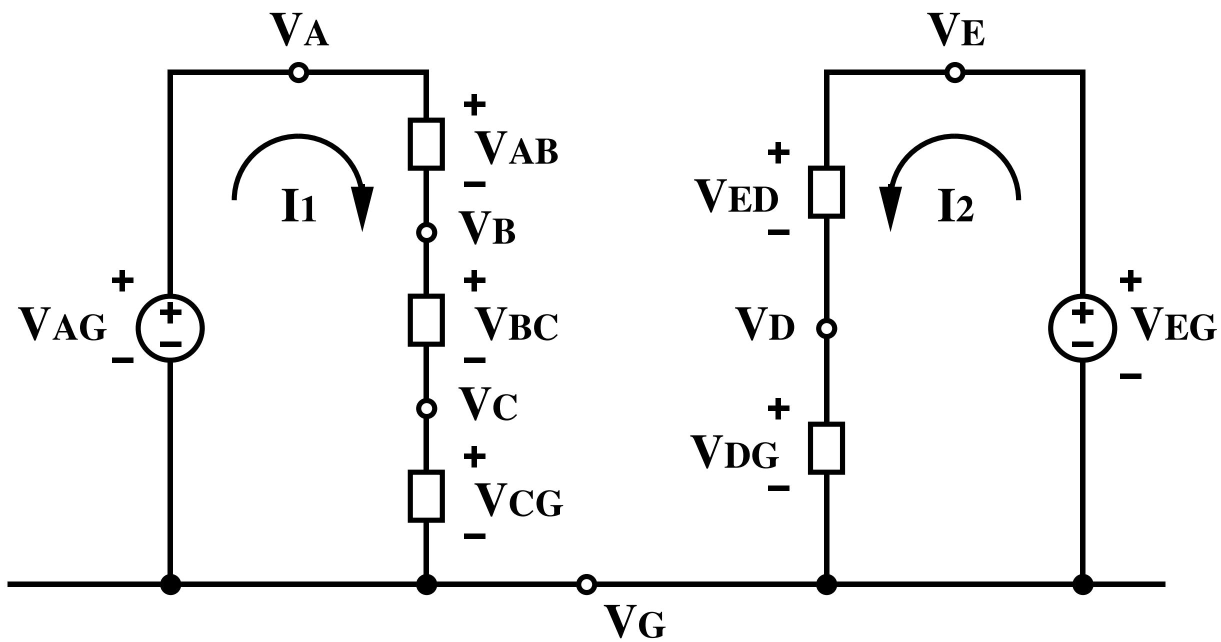
- **Voltage always relative (defined as a difference)**
- **Nomenclature / Conventions**
  - **V_A voltage at node A referenced to ground**
  - **$V_{BC} = V_B - V_C$ voltage drop from B to C**

KVL: Kirchhoff's Voltage Law

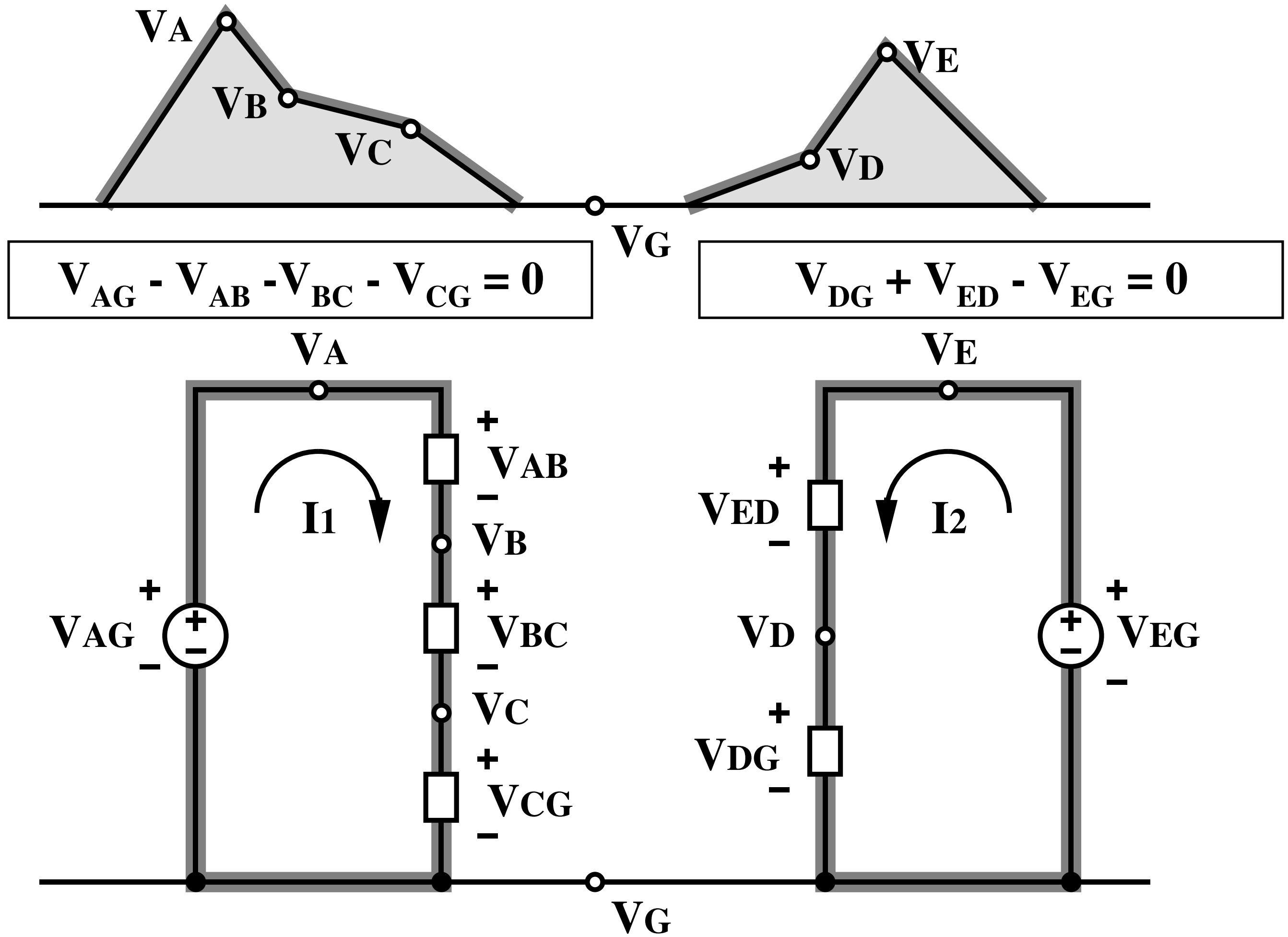
- **Sum of voltage drops around a loop = 0**
- **Voltage drop equations depend on element:**
  - **Ohm's law (R, L, C)**
  - **Value of voltage sources**
  - **Caution: ideal current source can have any voltage**
  - **Nonlinear model equations (diode, MOSFET, etc.)**

KVL Analogy: What goes up must come down



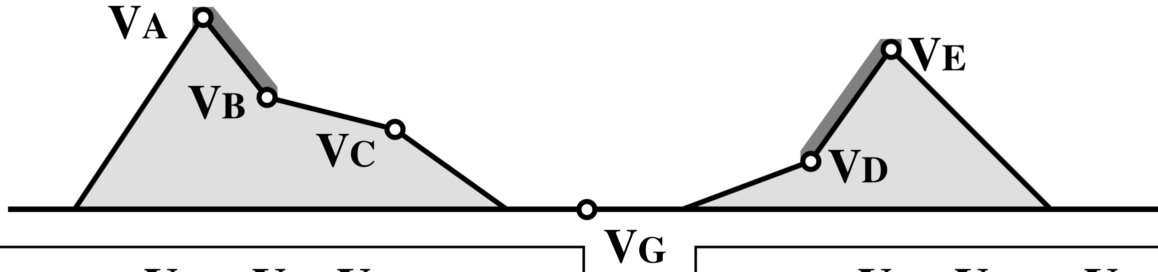


Formal KVL Loop



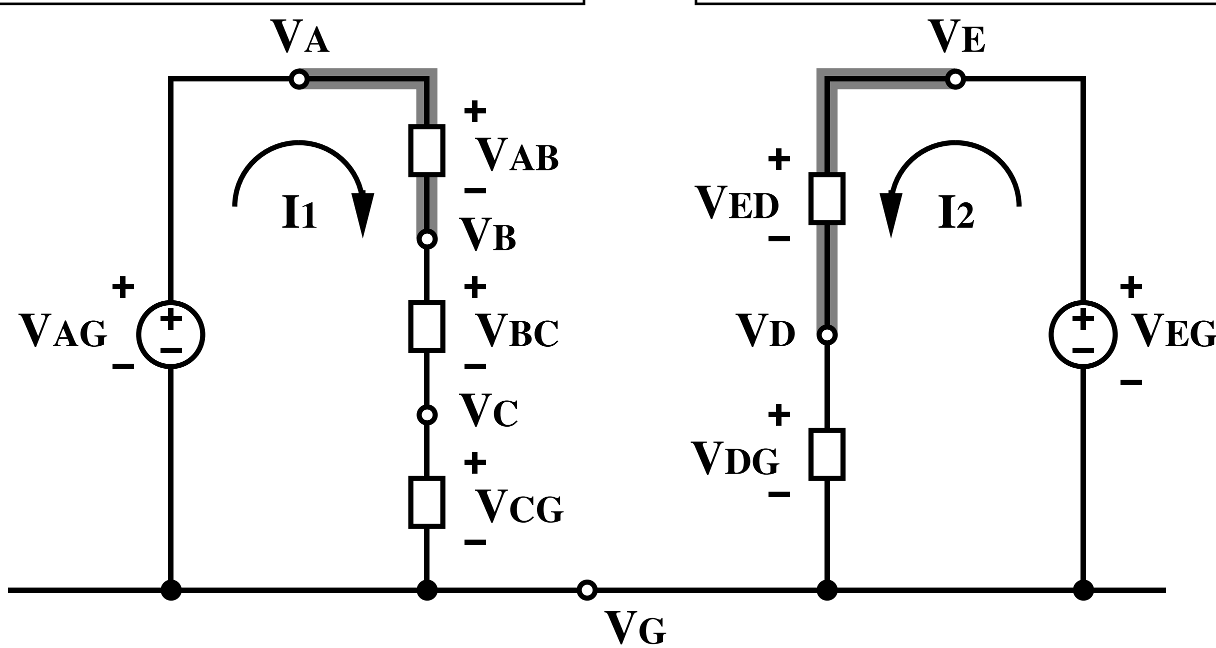
KVL Path

- **Simpler equation: don't always need entire loop**



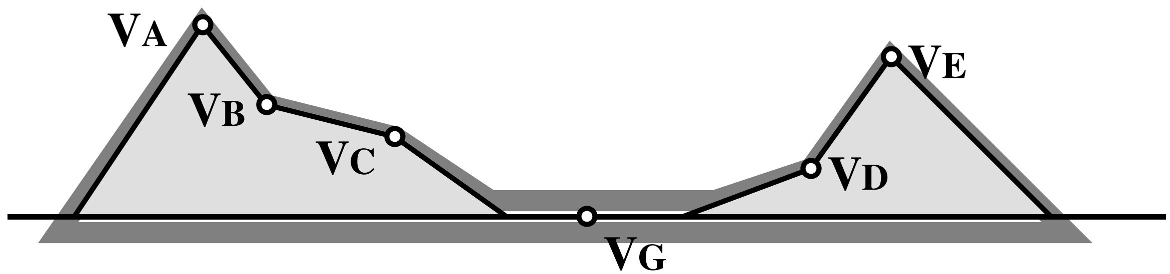
$V_B = V_A - V_{AB}$

$V_E - V_{ED} = V_D$

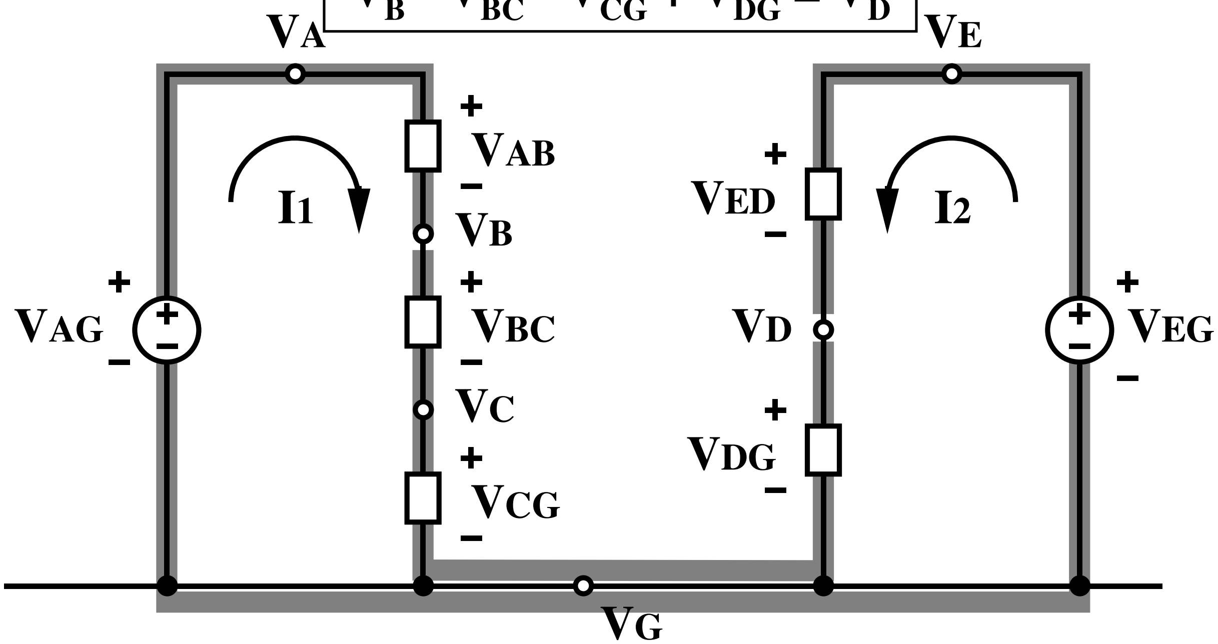


KVL Equations

- **Equations not unique: choose easier equation**



$$V_B - V_{BC} - V_{CG} + V_{DG} = V_D$$

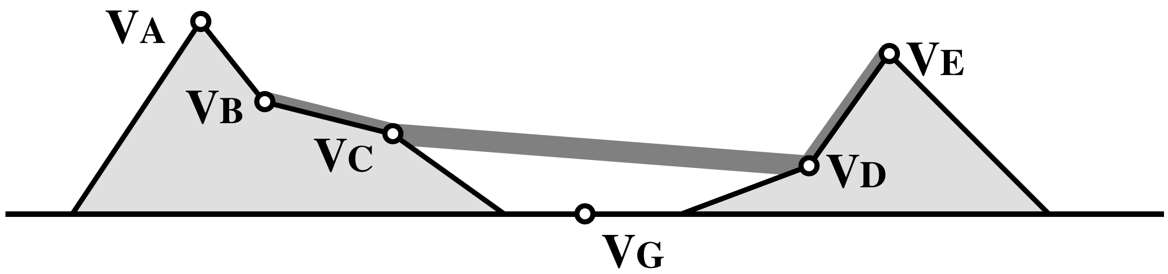


$$V_B + V_{AB} - V_{AG} + V_{EG} - V_{ED} = V_D$$

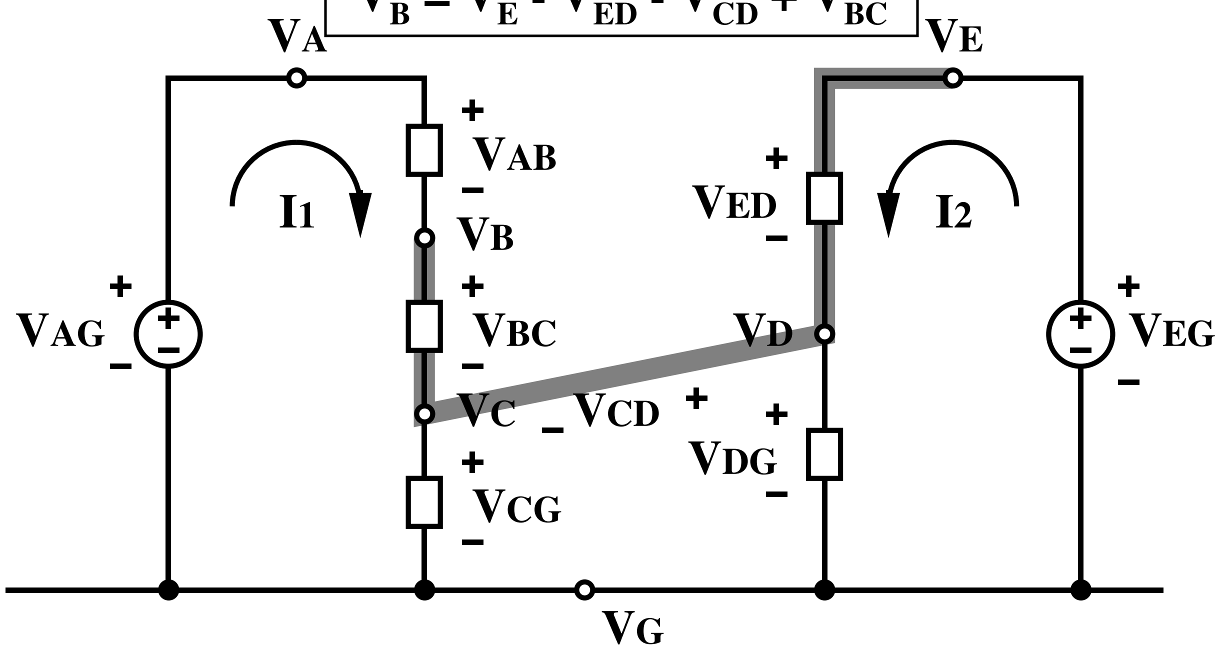
More terms, but V_{AG} and V_{EG} are (known) sources

KVL "Jump"

- **Define new voltage difference if appropriate**



$$V_B = V_E - V_{ED} - V_{CD} + V_{BC}$$



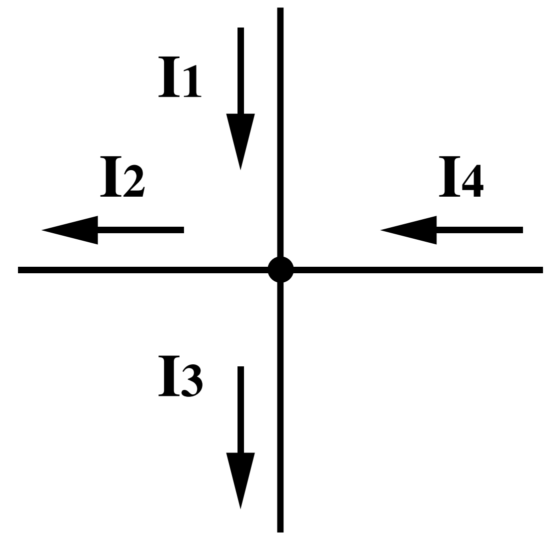
KCL: Kirchhoff's Current Law

- **Sum of currents at a node = 0**

$$I_1 - I_2 - I_3 + I_4 = 0$$

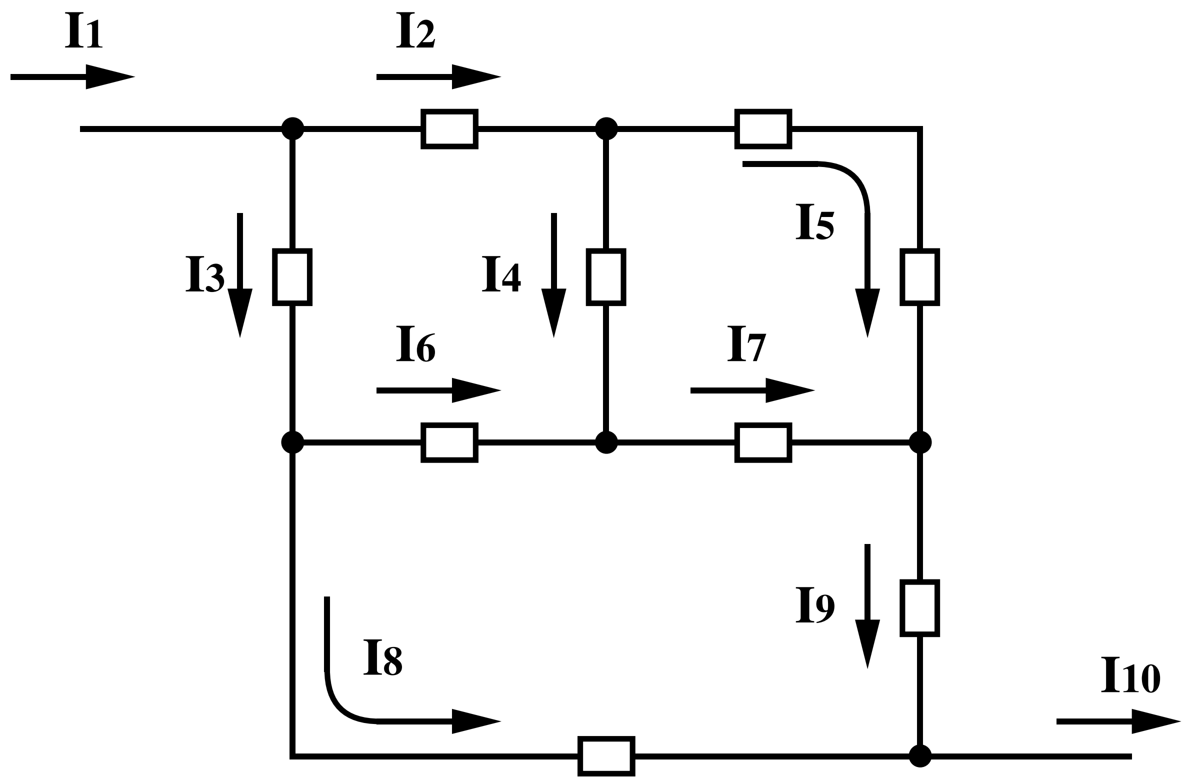
- **KCL:**
  What goes in must come out

$$I_1 + I_4 = I_2 + I_3$$



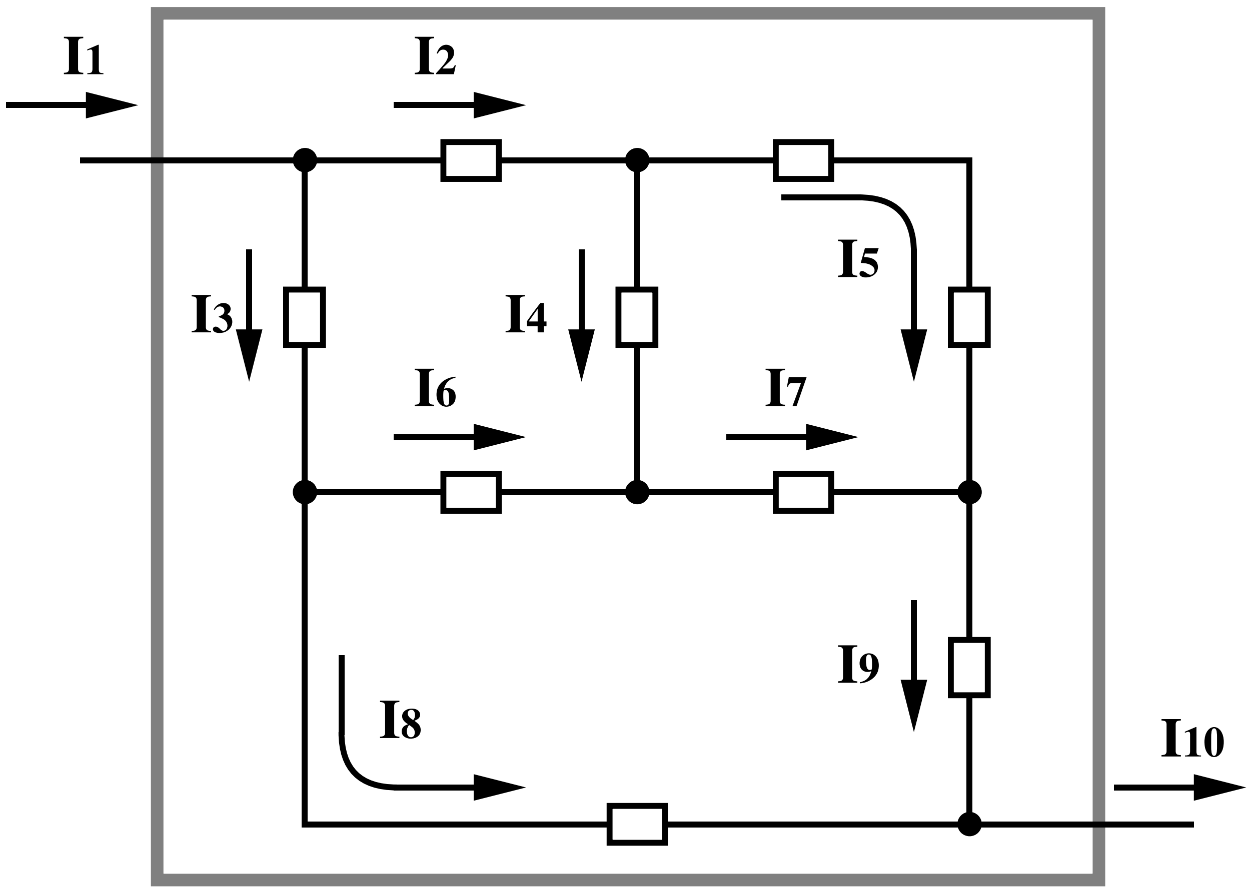
KCL Trouble

Example: Find I_{10}



“Supernode”: What goes in must come out

$$I_{10} = I_1$$



Thevenin's Theorem

- **Simplify linear network with equivalent circuit**