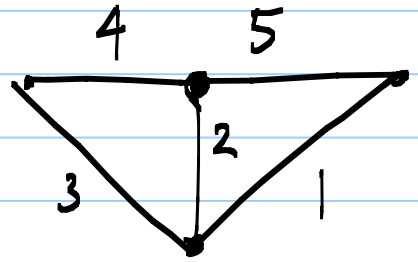
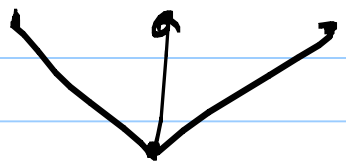
EC1010 : Lecture 10

Loop analysis

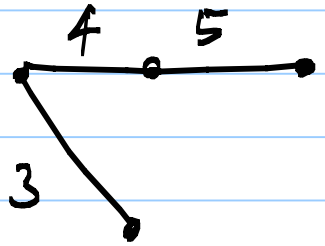
N nodes

B branches





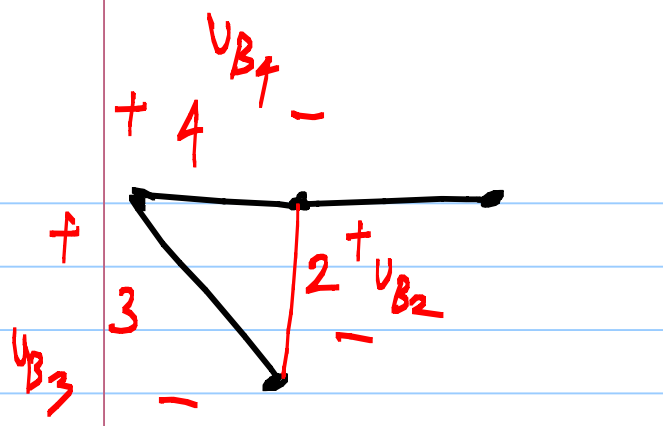
B-N+1 KVL equations



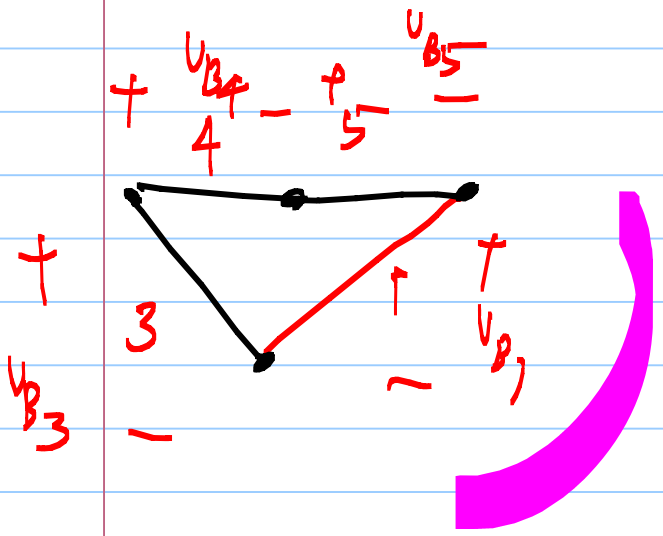
Tree: subset of branches which connect all N nodes without forming a loop.

Co-Tree: Graph − Tree

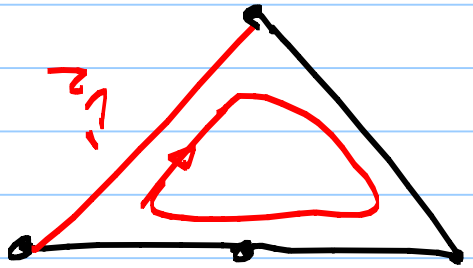
↳ Branches: links

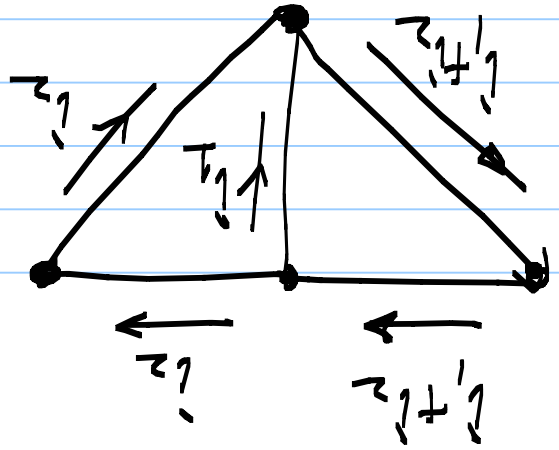


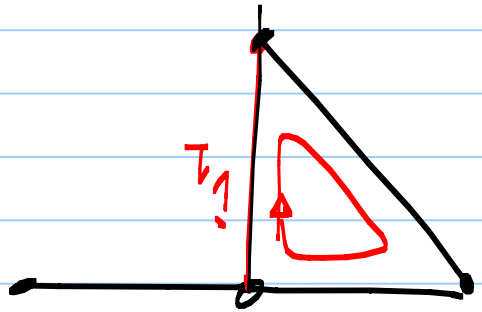
$$v_{B2} - v_{B3} + v_{B4} = 0$$

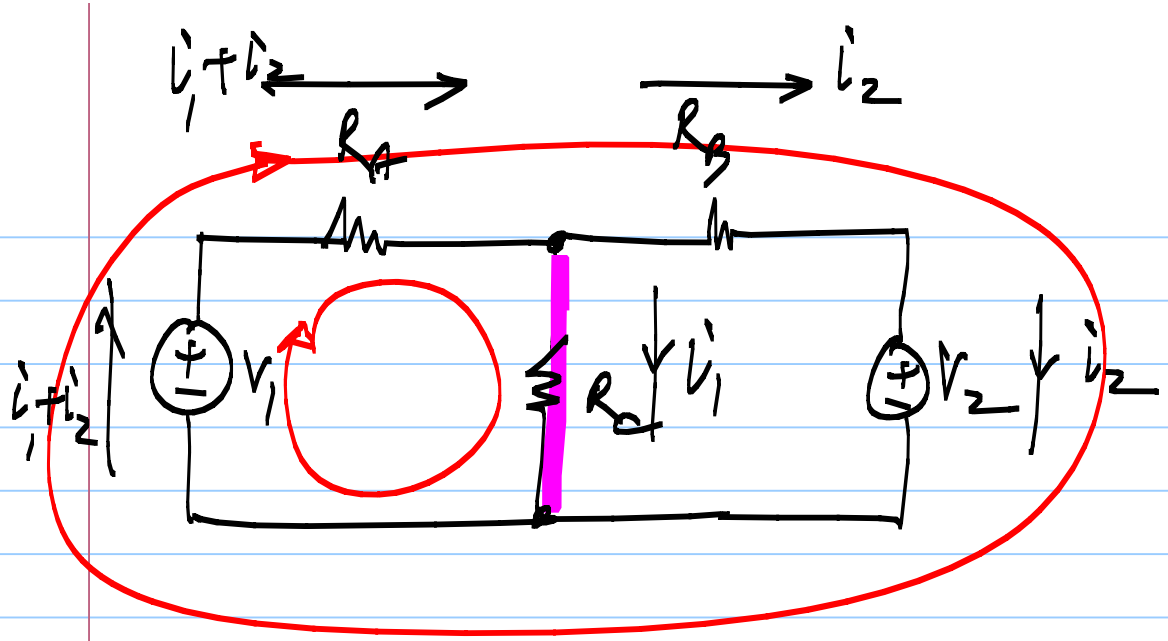


$$v_{B1} - v_{B3} + v_{B4} + v_{B5} = 0$$









$$\begin{bmatrix} R_A+R_C & R_A \\ R_A & R_A+R_B \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_1-V_2 \end{bmatrix}$$

$$[R]\ \underline{i} = \underline{V}$$

$$U_{B_2} - U_{B_3} + U_{B_4} = 0$$

$$i_1 \cdot R_C - V_1 + (i_1+i_2) R_A = 0$$

$$U_{B_1} - U_{B_3} + U_{B_4} + U_{B_5} = 0$$

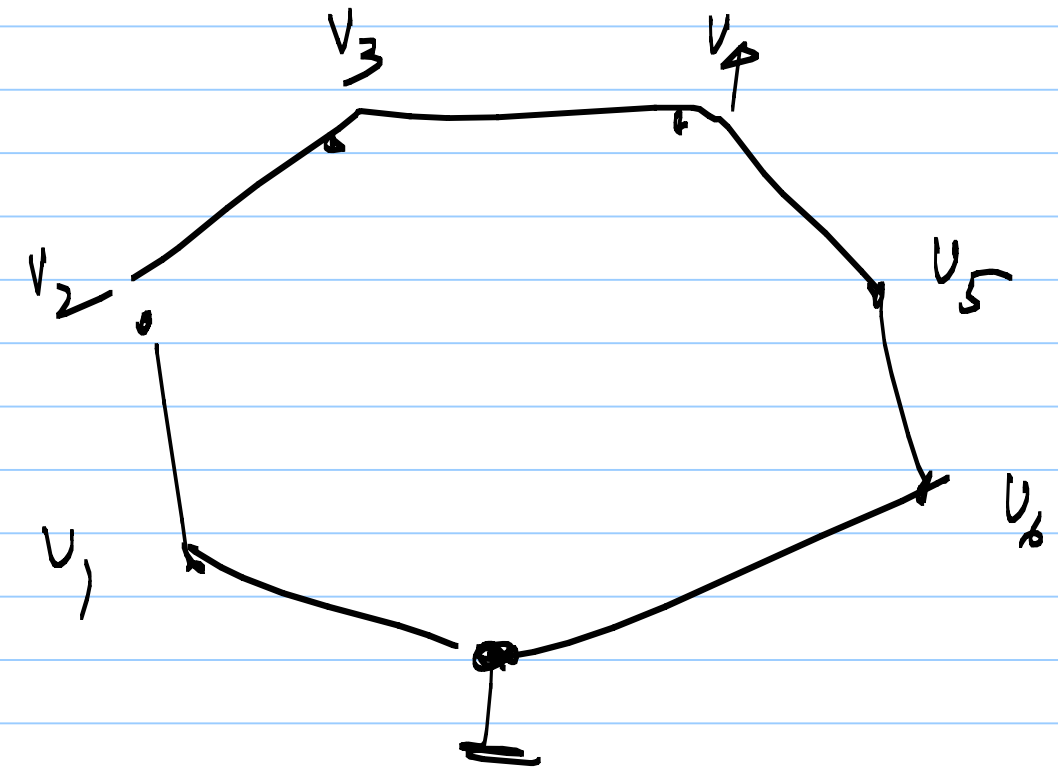
$$V_2 - V_1 + (i_1+i_2) R_A + i_2 R_B = 0$$

(Modified) Nodal analysis — Circuit simulators

N nodes — N−1 KCL equations ✓

B branches — B−N+1 KVL equations

$$N \le B \le \frac{N(N-1)}{2}$$



Solving a circuit: solve for all branch v, i

* Nodal analysis: node voltages wrt ref. node ✓

  Branch voltages: $v_k - v_l$

  Branch currents: Element relationship & branch voltage

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* Loop analysis: link currents

  Branch currents: $\sum_k i_k$

  Branch voltages: Element relationship & branch currents.