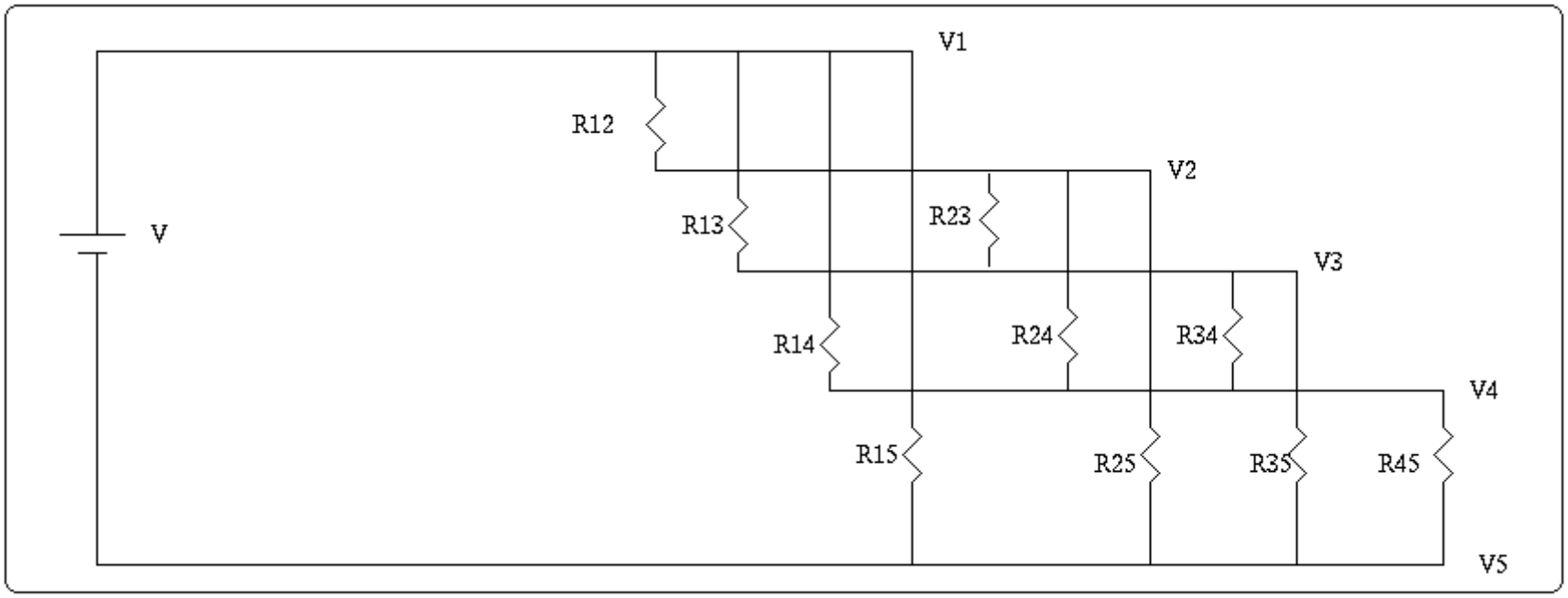
Phys699 - Statistical Methods in Data Analysis - Assignment #1



Given the above circuit it is possible to calculate the total current (I) applying Krichoff's laws

$$I = \sum_{i=1}^{5} (V_1 - V_i) \frac{1}{R_{1i}}$$

$$0 = \sum_{i=1}^{5} (V_2 - V_i) \frac{1}{R_{2i}}$$

$$0 = \sum_{i=1}^{5} (V_3 - V_i) \frac{1}{R_{3i}}$$

$$0 = \sum_{i=1}^{5} (V_4 - V_i) \frac{1}{R_{4i}}$$

where $\frac{1}{R_{ii}} = 0$

To solve for the 4 unknowns (I, V_2, V_3 and V_4) the last 3 equations may be re-arranged...

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$$-\sum_{i=1}^{5}\frac{1}{R_{2i}}V_2+\frac{1}{R_{23}}V_3+\frac{1}{R_{24}}V_4=-\frac{1}{R_{12}}V$$

$$\frac{1}{R_{23}}V_2-\sum_{i=1}^{5}\frac{1}{R_{3i}}V_3+\frac{1}{R_{34}}V_4=-\frac{1}{R_{13}}V$$

$$\frac{1}{R_{24}}V_2+\frac{1}{R_{34}}V_3-\sum_{i=1}^{5}\frac{1}{R_{4i}}V_4=-\frac{1}{R_{14}}V$$

where the identities $V_1 = V$ and $V_5=0$, have been applied.

Numerical methods can be used to find the voltages V2, V3 and V4 and, when substituted into the first equation on the pervious page, the total current I.

Produce a program that solves this problem for any number of voltage points between 3 and 20. Note the case when V=1 Volt, all resistors are present, and the value of the resistors are:

$$R_{ij} = |i-j|\Omega$$

Provide the following in your solution:
- a description of the problem
- development of your algorithm
- all code (use standard, concise and efficient coding practices).
- a final plot of current vs. number of voltage points

Hint: consider algorithms that apply matrix decompositon.