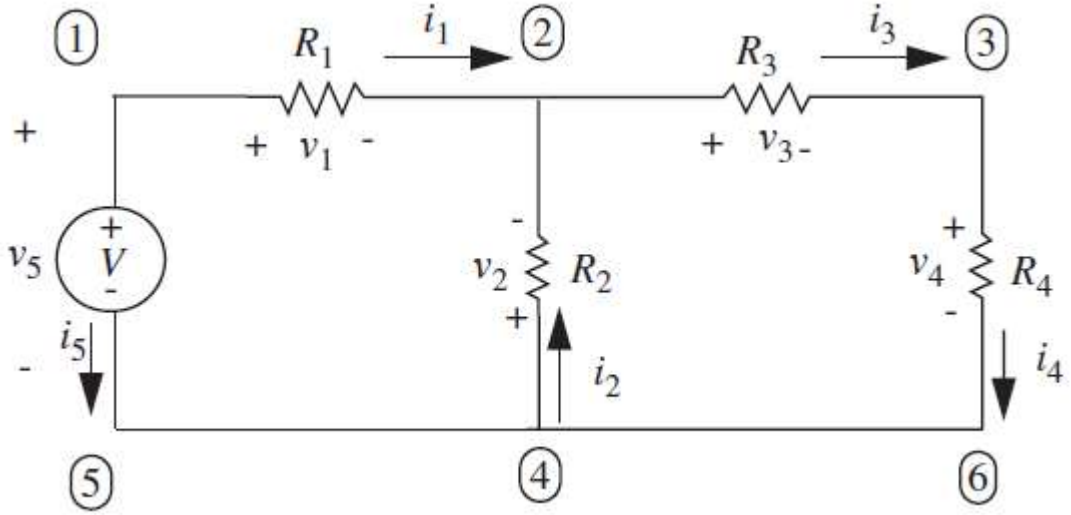
UNIV 2014 Assignment #2

Deadline: March 27, 2019

Electronically submit a zip file consisting of two Py files and a report. Also submit the print-outs of these files in class. Not submitting any of these at the deadline means you get a 0 grade.

Question 1

In electrical circuit analysis, the complete list of the branch equations, linearly independent Kirchhoff's Current Law equations, linearly independent Kirchhoff's Voltage Law equations is called tableau equations. By solving these equations, unknown voltages and currents can be found. Since the matrix equation to be solved is big and extremely sparse, it is generally not recommended to try to solve these equations by hand. Fortunately, today's computer systems can quickly solve these equations with efficient algorithms designed to solve sparse matrix equations.



For the above circuit, (1-5) are branch, (6-7) are KVL, (8-10) are KCL equations. Unknowns are $v1$, $v2$, $v3$, v4, v5, $i1$, $i2$, $i3$, $i4$, $i5$ and known voltage is V.

$$v1 = i1R1 \quad (1)$$
$$v2 = i2R2 \quad (2)$$
$$v3 = i3R3 \quad (3)$$
$$v4 = i4R4 \quad (4)$$
$$v5 = V \quad (5)$$

$$-v5 + v1 - v2 = 0 \quad (6)$$
$$+v2 + v3 + v4 = 0 \quad (7)$$

$$-i5 - i1 = 0 \quad (8)$$
$$+i1 + i2 - i3 = 0 \quad (9)$$
$$i3 - i4 = 0 \quad (10)$$

The above equations can be written in a matrix form in which constant voltage appear on the right-hand side of the equation. Solve the equations by a sparse solver in SciPy/Numpy in Python. V=12V, R1=10000 Ω, R2=12000 Ω, R3=18000 Ω, R4=8200 Ω.

Question 2

The linear algebraic equations above can be simplified by hand and the following matrix equation can be obtained. Solve the equation for unknowns *i*1, *i*4 using LU decompositions in SciPy/Numpy in Pyhton.

$$\begin{bmatrix} R1+R2 & -R2 \\ -R2 & R2+R3+R4 \end{bmatrix} \begin{bmatrix} i1 \\ i4 \end{bmatrix} = \begin{bmatrix} V \\ 0 \end{bmatrix}$$

You can use existing functions in your code to solve problems 1 and 2. Combine the codes of Question 1 and Question 2 in one Py file. Add comments describing the main properties of the algorithms used by solvers to the above of the code. Save the results in your report.

Question 3

Define two matrices A and b, and solve the matrix equation Ax=b using Reduced Row Echelon Form in Python. Write your own Python function to implement the algorithm in class notes to reach the row-reduced echolon form.

Prepare a Py file for solving the matrix equation. At the top of the function include a overview of the method and also add comments at steps describing the operation being done. Obtain the results at the end of each step, add them to your report.