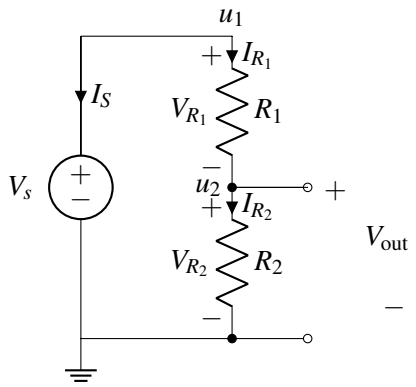
EECS 16A Designing Information Devices and Systems I
Fall 2021 Discussion 6A

1. Voltage Divider

For the circuit below, your goal will be to find the voltage V_{out} in terms of the resistances R_1, R_2, and V_s, using NVA (Node Voltage Analysis) and Gaussian elimination. The labeling steps (steps 1-4) have already been done for you.



Here is a reminder of the labeling steps followed to get the circuit diagram above:

- **Step 1:** Select a reference (ground) node. Any node can be chosen for this purpose. We will measure all of the voltages in the rest of the circuit relative to this point.
- **Step 2:** Label all nodes with voltage set by voltage sources.
- **Step 3:** Label remaining nodes.
- **Step 4:** Label element voltages and currents, following **Passive Sign Convention**.

Our goal is to ***find*** V_{out}. In order to do this, we can use NVA to find equations describing our circuit, write our equations in the form $\mathbf{A}\vec{x} = \vec{b}$, and use Guassian elemination to solve for $\vec{x}$. The following steps will walk you through this process:

Step 5: Write out $\mathbf{A}\vec{x} = \vec{b}$, leaving the entries for $\mathbf{A}$ and $\vec{b}$ blank. Next, fill in the enteries for $\vec{x}$. Recall that $\vec{x}$ is a vector of your unknown currents and voltages.

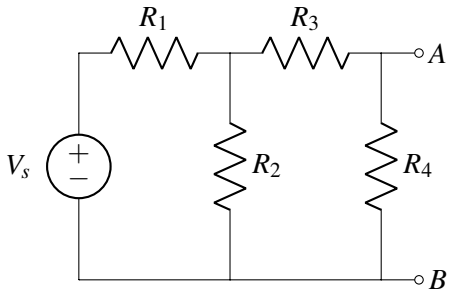
Step 6: Write KCL equations for all nodes with unknown voltages. Using these equations, fill in as many linearly indepedent rows in $\mathbf{A}$ and $\vec{b}$ as possible.

Step 7: Write down the IV relationships (Ohm's Law) of each of the non-wire elements. Use these equations to fill in the remaining rows in $\mathbf{A}$ and $\vec{b}$. (Hint: how many equations do you need to write?)

Step 8: Use Gaussian elimination or substition to solve for $u_2 = V_{out}$.

2. KVL and KCL

For the circuit shown below, $V_s = 5\,\text{V}$, $R_1 = R_2 = 4\,\text{k}\Omega$, and $R_3 = R_4 = 2\,\text{k}\Omega$.



(a) For the circuit above, write KVL equations for each loop and KCL equations for each node.

(b) Solve for the voltage between A and B using the equations from part (a).