Linear Algebra Applications to Kirchhoff Laws for Adaptive Circuit Analysis

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#: METHODS

The code, taking in voltage and resistance, that was designed for this specific circuit is as followed:

```java
public void swapRows(int row1, int row2)
    double temp;
    for(int i=0;i<numEq;++i) { // SWAPPING CO-EFFICIENT ROWS
        temp = m[row1][i];
        m[row1][i] = m[row2][i];
        m[row2][i] = temp;
    }
    // SWAPPING CONSTANTS VECTOR
    constants[row1] = constants[row2];
    constants[row2] = temp;
}
```

The circuit used for this project is illustrated below:

[Diagram of the circuit with labels: 30 V at the top, 10 V at the right, 15 Ω at the bottom, 5 Ω and 20 Ω on the left, and 3 currents labeled I₁, I₂, I₃.]

The circuit has two sources of voltage, a 10 V and 30 V. There are three resistors in parallel of 5, 20, and 15 Ohms. The system of linear equations that can represent the circuit are as followed:

\[
\begin{align*}
I_1 + I_2 - I_3 &= 0 \\
5I_1 + 20I_2 &= 40 \ V \\
5I_1 + 15I_2 &= 20 \ V
\end{align*}
\]

#: RESULTS & SUMMARY

Our code allows for voltage and resistance input and outputs currents through each resistor. While this code is specific for the circuit we are working with, this can be used as a template for more complicated circuit designs. The Node and Voltage Laws still apply to more complicated systems because of the conservation of energy in the system. More complicated circuits will merely have more equations and more variables.

#: CONCLUSION

Components have threshold voltage and currents that they operate under

Resistors and capacitors will explode or catch fire if the current and/or voltage is too high. Using this code as a launch pad, engineers can quickly calculate the current through each component and verify that it is within the operating threshold.

Linear Algebra eases the process of interfacing and repair components

Since current through each component can be monitored using a simple augmented matrix, engineers can focus more on their hardware and less on the math.

#: ACKNOWLEDGEMENTS
