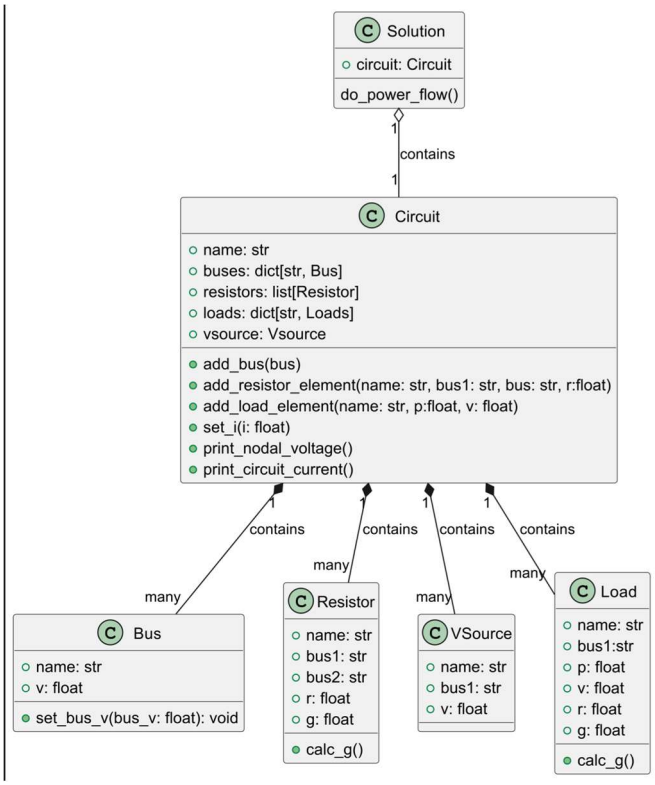
ECE 1774 Project 1: Simple Circuit

Overview:

The purpose of this project is to develop a Python script capable of simulating real-world power systems. I developed a Python model that solves a DC circuit consisting of a voltage source, series resistor, and load connected between two buses. While this model is currently limited to simulating this specific circuit, it serves as a foundational introduction to power system modeling capabilities and demonstrates the core object-oriented architecture that can be extended to more complex networks.

Class Diagrams:



Relevant Equations:

Ohms Law: $V = IR$

Power-Voltage Relationship: $P = IV = \frac{V^2}{R}$

Calculation conductance: $G = \frac{1}{V} = \frac{1}{R}$

KVL Solution:

$$V\_source - V\_resistor - V\_load = 0$$

$$V\_a - I * R\_series - V\_b = 0$$

$$V\_b = V\_a - I * R\_series = R\_load$$

Example Case:

To show the accuracy of the simulation, we will do an example test case using different values to validate the system under varying conditions. The circuit is composed of**:**

- Buses A and B
- Voltage source V_a connected at bus A with 200 V
- Resistor R_ab connected between buses A and B with 20 Ohms
- Load L_b connected to bus B with power of 300 W and nominal voltage of 100 V.

Solution Process:

1) The voltage at the source directly sets the voltage at Bus A

2) For a constant impedance load model, the load resistance is calculated using the nominal voltage and power rating:

R_load = V²_nominal / P_load = (100)² / 3000 = 3.33 Ω

3) The series resistor and load resistor form a series circuit:

R_total = R_ab + R_load = 20 + 3.33 = 23.33 Ω

4) Using Ohm's Law with the total circuit resistance:

I = V_A / R_total = 200 / 23.33 = 8.57 A

5) Using the voltage divider principle or Ohm's Law across the load:

V_B = I × R_load = 8.57 × 3.33 = 28.57 V

Simulation Results:

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Nodal Voltages for Circuit: SimpleCircuit
Bus A: 200.00 V
Bus B: 28.57 V

Circuit Current for: SimpleCircuit
Current: 8.5714 A
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