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Advanced Power System Analysis, ECE 2774

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Project Documentation for Simple Circuit, Project 1

# Introduction

This simple circuit simulator enables users to analyze a DC circuit by defining two buses, applying a voltage source to the first bus, placing a resistor between the buses, and connecting a load to the second bus. The program computes the total circuit current and determines the voltage at the second bus. Below is a visual representation of the circuit along with the fundamental equations used in the analysis. Significant effort has been made to provide thorough comments within the code for clarity. Finally, the program outputs the calculated values, including the voltages at both buses and the total circuit current, as follows:

1. Bus A Voltage is ''”
2. Bus B Voltage is ''”
3. Circuit Current is ''”

A diagram of a bus

AI-generated content may be incorrect.

# Problem Example

This program has defined a DC circuit by defining a voltage source at Bus A to be 100V, defining a resistance between Bus A and Bus B to be 5 Ohms, and the load at Bus B to be rated for 2000W and 100V. The program performs the calculations and outputs the following:

* Bus A voltage = 100V
* Bus B voltage = 50V
* Circuit Current = 10A

Class OrganizationA screenshot of a computer

AI-generated content may be incorrect.

# Class Definitions

**1. Resistor Class**: The Resistor class models an electrical resistor, connecting two buses and providing a resistance value. It also calculates the conductance, the reciprocal of the resistance, during initialization.

**2. Bus Class**: The Bus class represents a node in the circuit where multiple electrical components can connect. Each bus maintains a list of connected components and can calculate the total current and voltage at that bus.

**3. VoltageSource Class**: The VoltageSource class models a voltage source that provides a constant voltage to the circuit. It is connected to a bus and affects the voltage and current in the circuit.

**4. Load Class**: The Load class represents a load connected to a bus in the circuit. It consumes power and impacts the voltage and current at the bus to which it is connected.

**5. Circuit Class**: The Circuit class represents the entire circuit. It manages the components (buses, resistors, voltage sources, and loads) and performs calculations to determine the overall current and voltage at each bus.

**6. Calculation Class**: The Calculation class handles the mathematical computations required to analyze the circuit. It calculates the total current flowing in the circuit and the voltage at each bus based on the connected components and their values.

**7. Display Class**: The Display class is responsible for presenting the results of the circuit analysis. It displays the calculated values such as the voltages at the buses and the total circuit current.

**Main Class -** Program Execution

The **Main Class** serves as the entry point for the program, responsible for defining the circuit structure and executing the power flow analysis. It performs the following steps:

1. **Circuit Initialization**
   * Creates a **Circuit** instance labeled **"Simple DC Circuit for Project One - Advanced Power System Analysis at Pitt, Graduate Level."**
   * Adds two buses, **Bus A and Bus B**, to serve as connection points.
2. **Component Definition**
   * Adds a **100V voltage source** at **Bus A**, setting the reference voltage.
   * Connects a **5-ohm resistor** between **Bus A and Bus B**, introducing resistance.
   * Adds a **2000W load with a nominal voltage of 100V** at **Bus B**, modeled as a constant impedance load.
3. **Circuit Simulation**
   * Creates an instance of the **Solution Class** to perform power flow calculations.
   * Computes nodal voltages and circuit current using **Ohm’s Law** and **Kirchhoff’s Voltage and Current Laws**.
4. **Result Display**
   * Outputs the final computed values:
     + **Bus A voltage: 100V**
     + **Bus B voltage: 50V**
     + **Circuit current: 10A**

These classes work together to model and simulate a DC circuit, allowing users to define components, perform calculations, and view results with clarity.

**Final Thoughts**

This project demonstrates the fundamentals of DC power system analysis using object-oriented programming. By leveraging modular class design, it allows for flexible circuit modeling and accurate power flow computations. Through detailed implementation and documentation, this program provides a solid foundation for understanding fundamental electrical circuit analysis techniques.

As one new to Python 3, I appreciate this project, as it helped me learn lots of python and review electrical engineering basics.