

# Determining the Complexity of Parallel Circuits: A Proposal

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## Abstract

The goal of the experiment is to determine if Parallel Circuits are *NP*-Complete or *P*-Complete. For this purpose, parallel circuits will be augmented with switches, which will be modelled in a computer program's logic flow. To start, three parallel circuits are to be constructed, consisting of 1,2, and 3 resistors respectively. From there, induction will be utilized to attempt to prove that the number of resistors can go up to infinity. The experiment is a form of inquiry into the prospect of modelling circuits using computers, which has numerous potential applications. It will also attempt to speculate, depending on the results, if  $P = NP$ .

## 1 Introduction

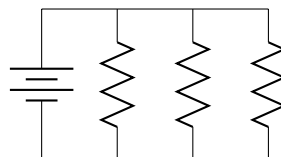
### 1.1 Parallel Circuits

A **Parallel Circuit** is a variation of circuit that, in its most elemental version, separates  $I_{net}$  into separate branches, dedicating a resistor for each branch. The general idea behind a parallel circuit is that each resistor receives an independent supply of  $I$ , such that if one resistor loses  $I$ , the other resistors maintain  $I$ . The following relationships are derivable using Ohm's Law ( $V = IR$ ):

$$V_{net} = V_1 = V_2 = \dots = V_n$$

$$I_{net} = \Sigma I_n$$

$$\frac{1}{R_{net}} = \Sigma \frac{1}{R_n}$$



Several unique properties emerge if  $V$ ,  $I$ , and  $R$  values are tracked over changes made to the circuit, such as removing/adding a resistor, changing  $V$ , etc. Those systematic changes will become central to the experiment.

## References