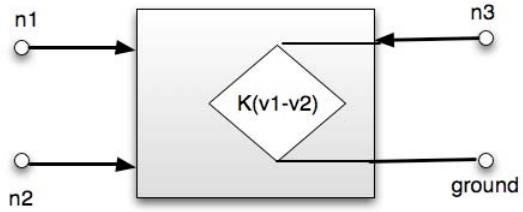
Problem Wk.8.1.3: Modeling Op-Amps

Read the Software Lab 8 Handout before doing these problems. Also read Section 6.6 of the Course Notes.

Part 1: Op-Amp Constraint

If you have an op-amp with gain `K` connected with inputs `n1` (the positive input voltage) and `n2` (the negative input voltage) and output `n3` (assume the negative output is tied to voltage 0), what constraint does it exert on the voltages `n1`, `n2` and `n3`? Assume the voltage-controlled voltage-source model in Section 6.6.1 of the Course Notes.



Choose the coefficient for each term. Pick the first non-zero coefficient to be positive; this is an arbitrary choice, but it makes checking easier.

1. ?
   0
   1
   -1
   K
   -K

   * n1 + ? * n2 + ? * n3 = ?

Part 2: Op-Amp Currents

If you have an op-amp with gain `K` connected with inputs `n1` and `n2` and output `n3` (assume the negative output is tied to ground (zero voltage)), what constraint does it exert on the currents `i1`, `i2` and `i3` going into the op-amp at the corresponding nodes? Assume the voltage-controlled voltage-source model in Section 6.6.1 of the Course Notes.

1. `i1` is
   ?
   unconstrained by op-amp
   equal to 0
   greater than 0
   less than 0

   So, for simplicity, we can
   ?
   only include i1 in op-amp equation
   only include i1 in KCL equation at n1

This problem contains one or more multiple-choice questions. When a given set of choices is used for the first time, all choices are displayed. If there are several related questions, you can assume that the same choices are available for all questions.

include i1 in op-amp equation and KCL equation at n1
not include i1 in any equation

2. `i2` is
   ?
   unconstrained by op-amp
   equal to 0
   greater than 0
   less than 0

   So, for simplicity, we can
   ?
   only include i2 in op-amp equation
   only include i2 in KCL equation at n2
   include i2 in op-amp equation and KCL equation at n2
   not include i2 in any equation

3. `i3` is
   ?
   unconstrained by op-amp
   equal to 0
   greater than 0
   less than 0

   So, for simplicity, we can
   ?
   only include i3 in op-amp equation
   only include i3 in KCL equation at n3
   include i3 in op-amp equation and KCL equation at n3
   not include i3 in any equation

Part 3: Op-Amp

Finish the implementation of the Op-Amp class.

```
class OpAmp(Component):
    def __init__(self, nPlus, nMinus, nOut, K=10000):
        self.K = K
        self.nPlus = nPlus
        self.nMinus = nMinus
        self.nOut = nOut
        self.current = util.gensym('i->'+nOut)

    def getCurrents(self):
        # the current at the op-amp output
        return [[self.current, self.nOut, +1]]

    def getEquation(self):
        # your code here
```

6.01SC Introduction to Electrical Engineering and Computer Science

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