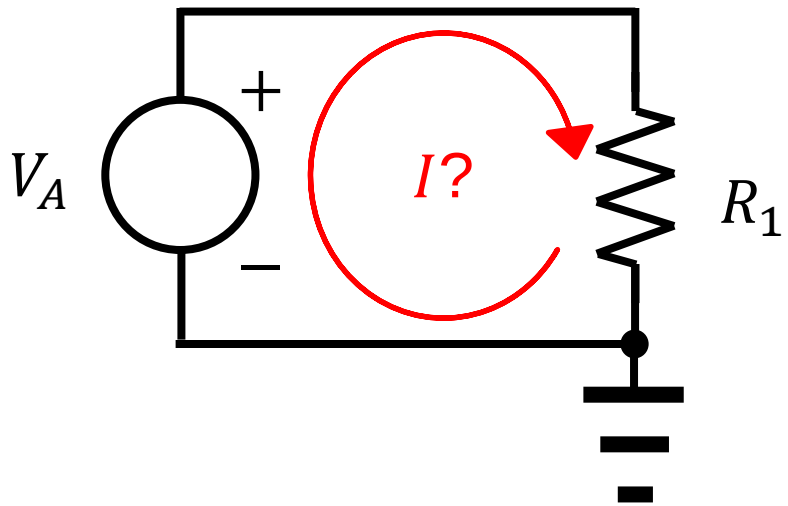
Lecture1:
Circuit theory

Sung-Min Hong (smhong@gist.ac.kr)

Semiconductor Device Simulation Lab.
School of Electrical Engineering and Coumputer Science
Gwangju Institute of Science and Technology

A simple problem

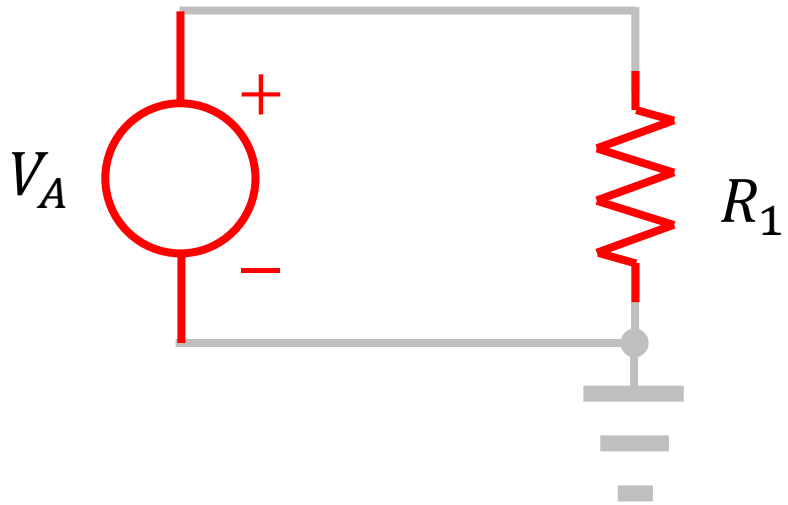
- Solve the problem.
  - What is the current?



  - It is an easy problem.

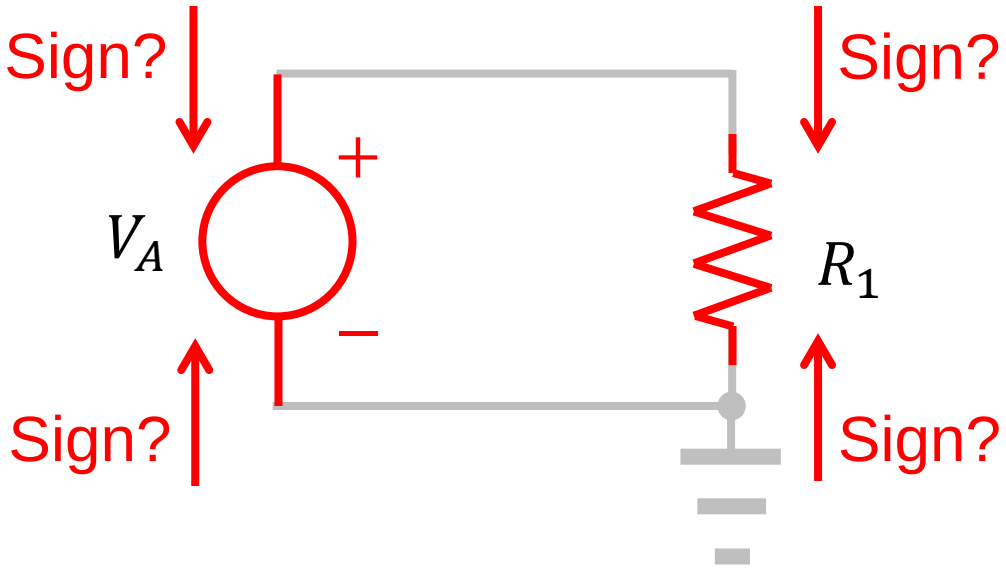
Elements

- Resistors, capacitors, etc
  - They can have multiple terminals.
  - A resistor has two terminals.
  - A diode has two terminals.
  - A MOSFET has three (or four) terminals.



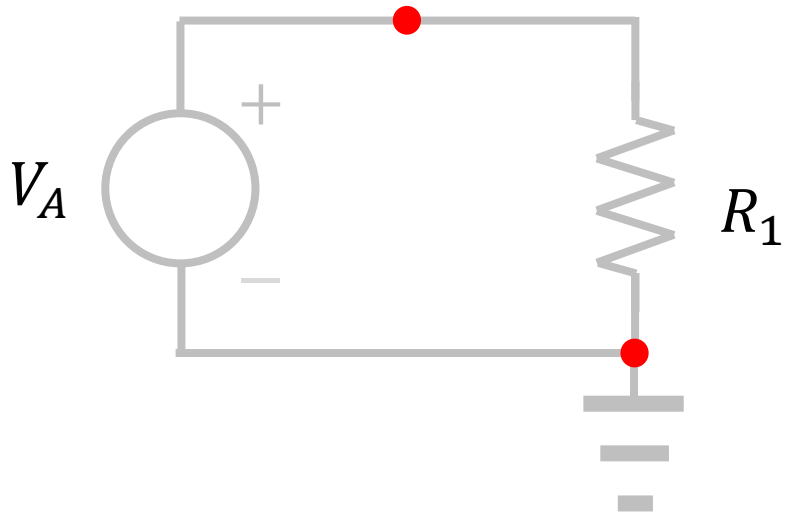
Convention for current

- Terminal current
  - Conventionally, an in-coming current is regarded as positive.



Nodes

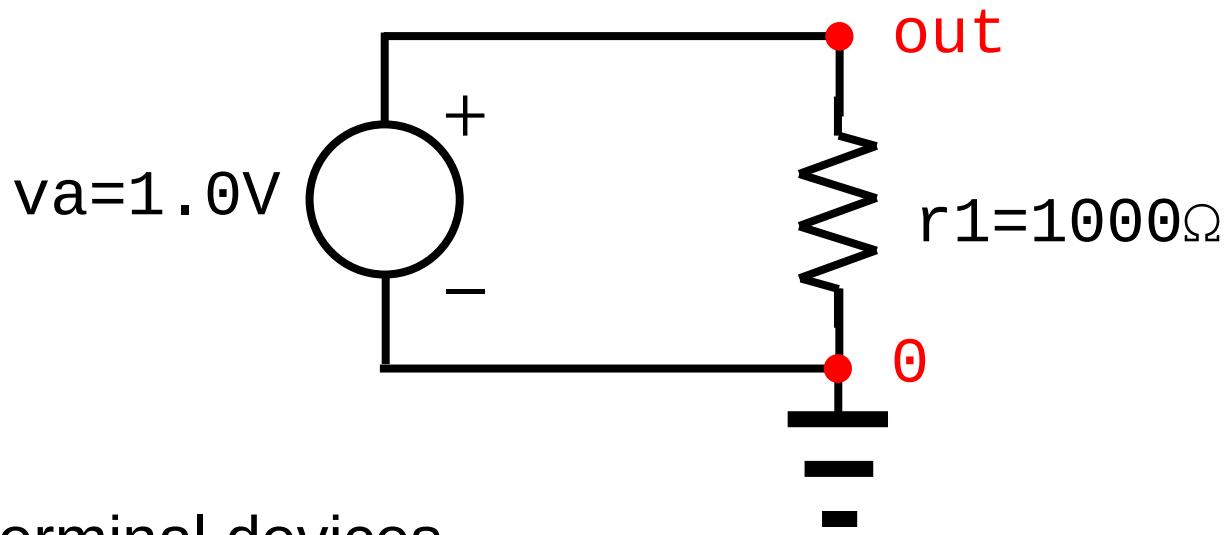
- A point to which multiple terminals are tied.
  - (Usually, a dot is used to represent a node.)
  - There is a special node, GND.



How to describe a circuit

- Of course, we can draw a circuit schematic. What else?
- A netlist for this circuit looks like:

```
va out 0 1.0
r1 out 0 1000
```



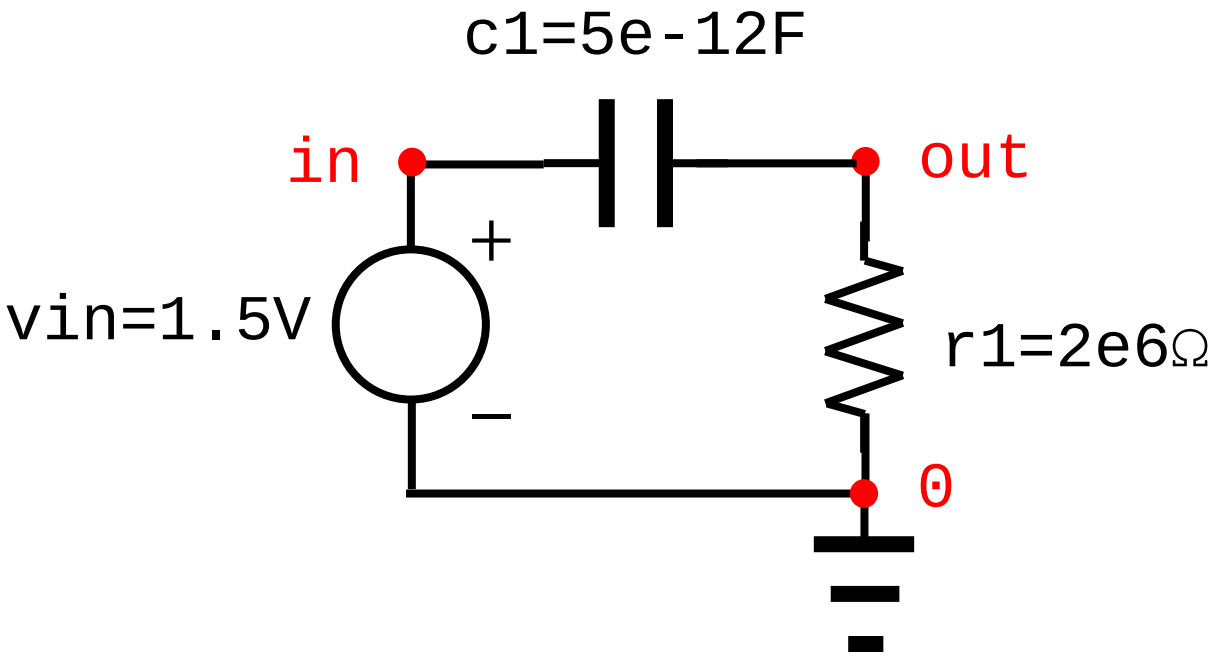
- Format for two-terminal devices

```
elementlabel node1 node2 value
```

RC filter

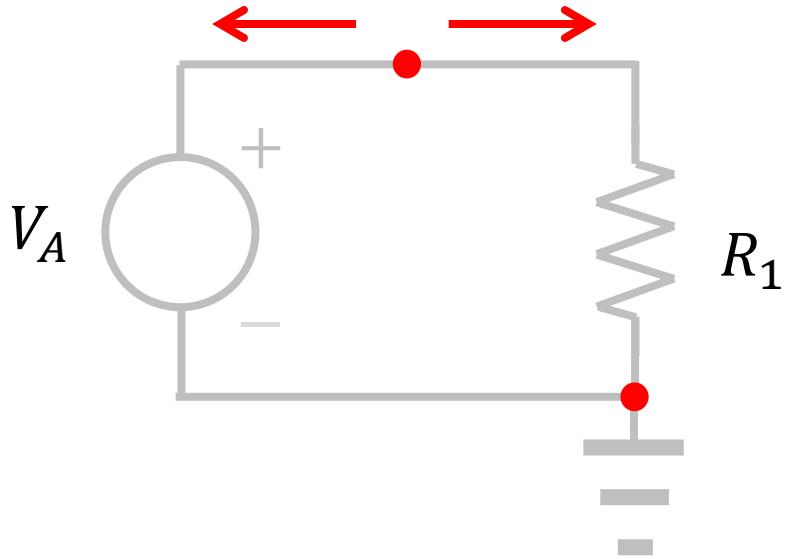
- A netlist for this circuit looks like:

```
c1 in out 5e-12
r1 out 0 2e6
vin in 0 1.5
```



Circuit analysis (1)

- The basis principle of circuit analysis is…
  - Kirchhoff's current law (KCL)!
  - At any node in an electrical circuit, the sum of currents flowing into that node is equal to the sum of currents flowing out of that node.



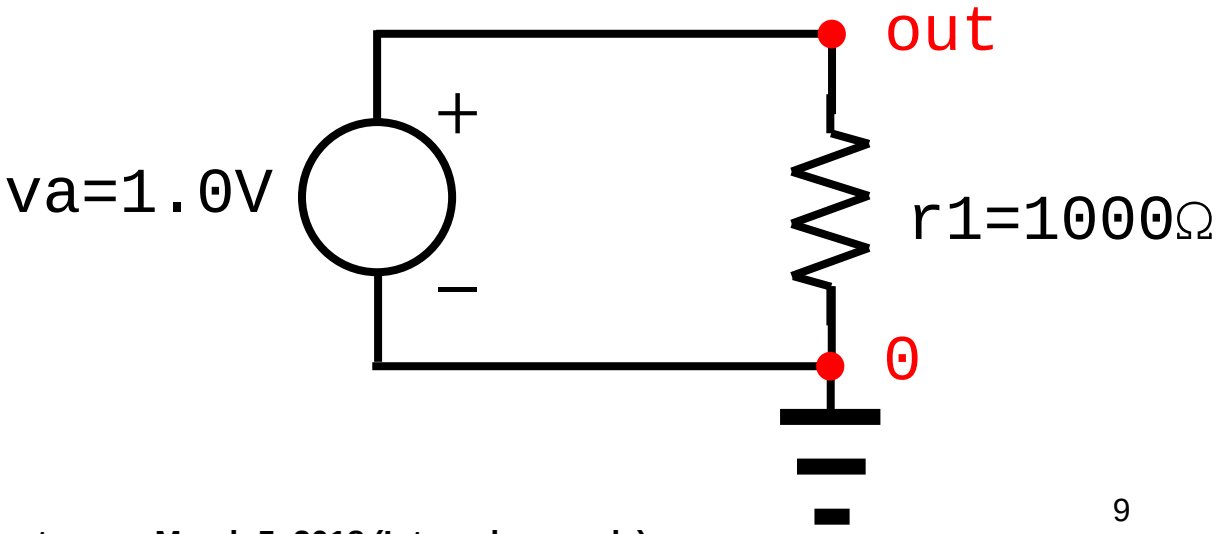
Circuit analysis (2)

- Our simple problem
  - Following equations are identified.

$I_{va} + I_{r1} = 0$ KCL

$V(out) - 0.0 = 1.0$ Voltage source

$I_{r1} = \frac{V(out)}{1000}$ Resistor



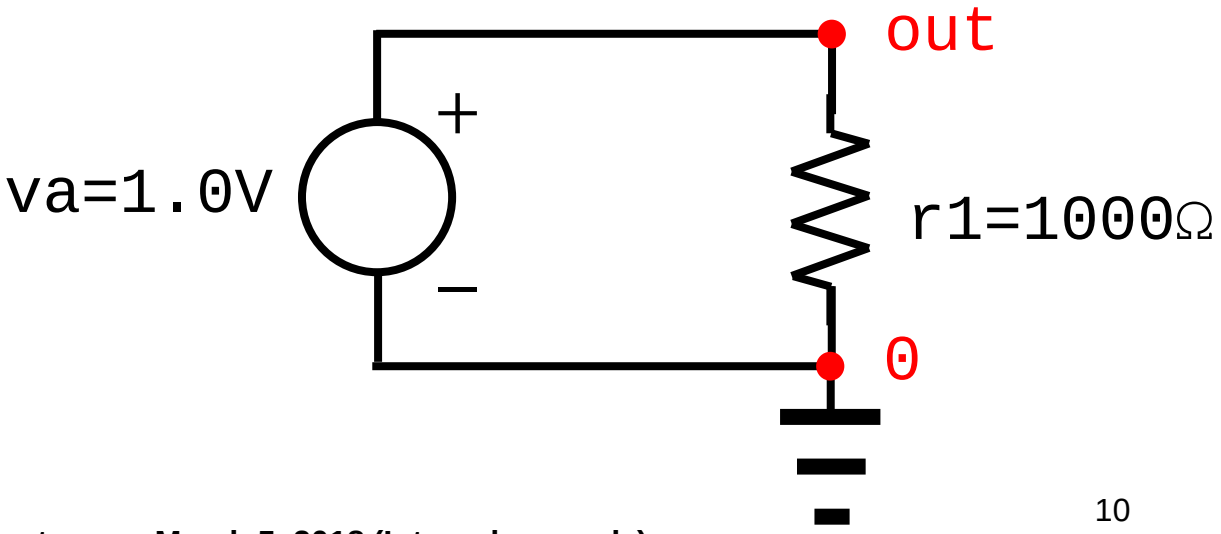
Circuit analysis (2)

- Our simple problem
  - Following equations are identified.

$I_{va} + I_{r1} = 0$ KCL

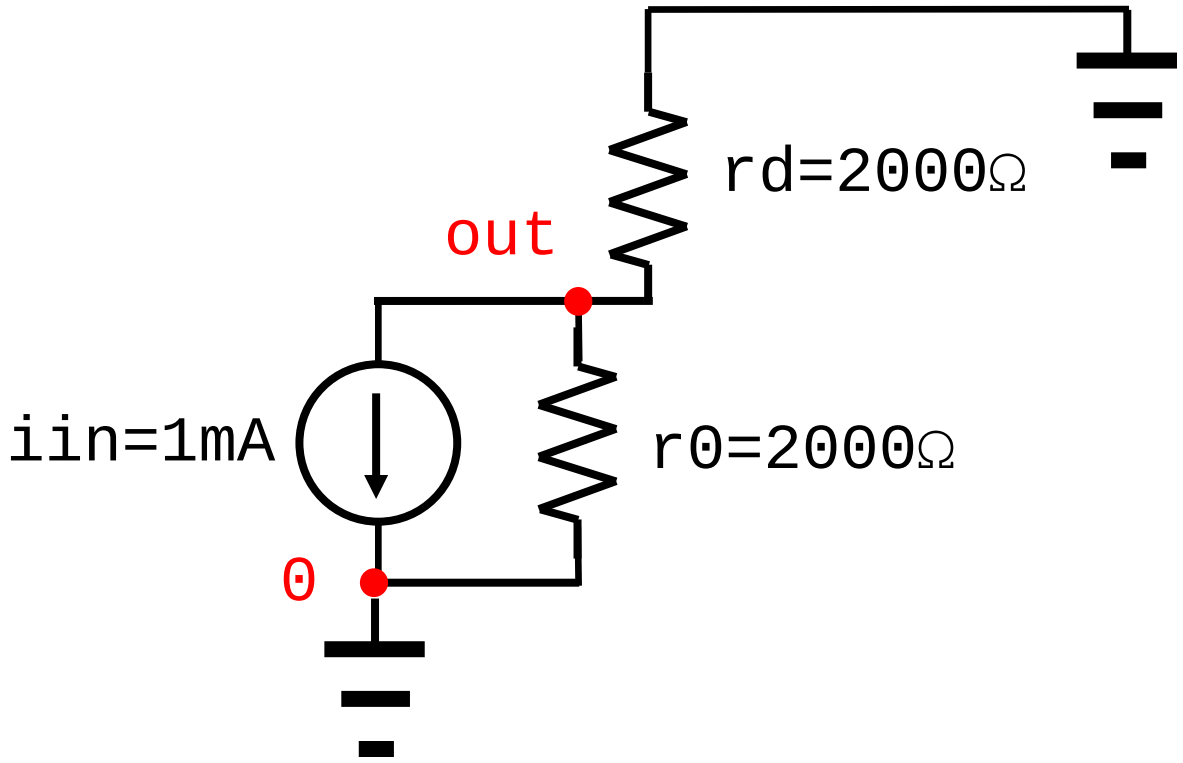
$V(out) - 0.0 = 1.0$ Voltage source

$I_{r1} = \frac{V(out)}{1000}$ Resistor



Circuit analysis (3)

- Our real-world example
  - Write a netlist.
  - Calculate the node voltage of `out`.



Homework#1 (1)

- Due: 09:00, March 12
  - Submit your Homework answer sheet (hardcopy) to Mr. Geon-Tae Jang, our TA.
  - His office: EECS building C-411

- Write a simple program.
  - It accepts an input file name.
  - It prints “Hello, world!”
  - It prints the contents for the input file.
  - It prints “Bye!”

  - (Attach the source code and the screen shot.)

Homework#1 (2)

- Draw a circuit schematic of the following netlist.

```
v1 batt 0 1.5
r1 batt xx 1000
r2 xx yy 2000
r3 yy 0 2000
r4 yy 0 3000
```