

# Electric Circuits

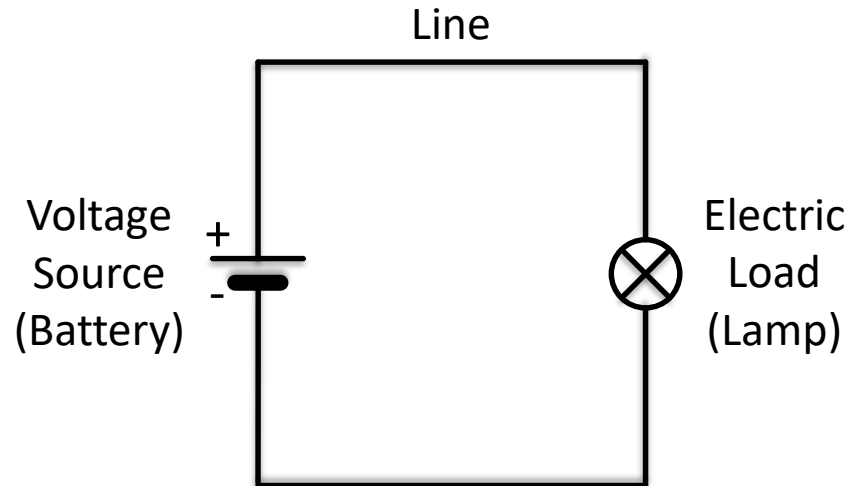
Networks and Embedded Systems

First Grade Level

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# Electric Circuit (1)

- Structure
  - Voltage source
    - Battery
  - Electric Load
    - Lamp
  - Electrical wiring
    - Line
    - Cable



# Electric Circuit (2)

- Basics

- Voltage source

- A voltage is applied
    - Voltage  $V$ , [V] (Volt)

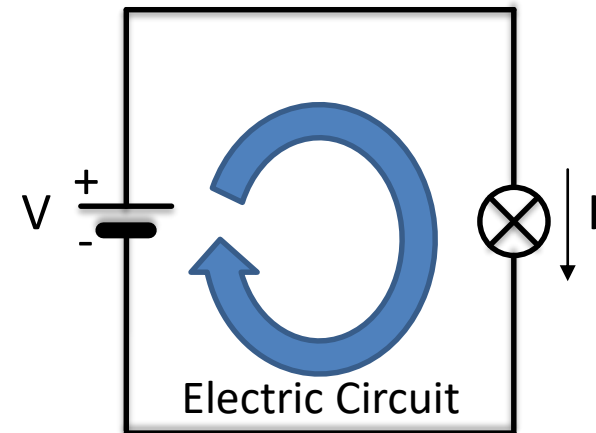
- Electric Load

Unit

- A current flows through
    - Electric current  $I$ , [A] (Ampere)

- Conventional direction of current

- The current flows from plus (+) to minus (-)



# Electric Circuit (3)

- Electric Circuit

- Resistor

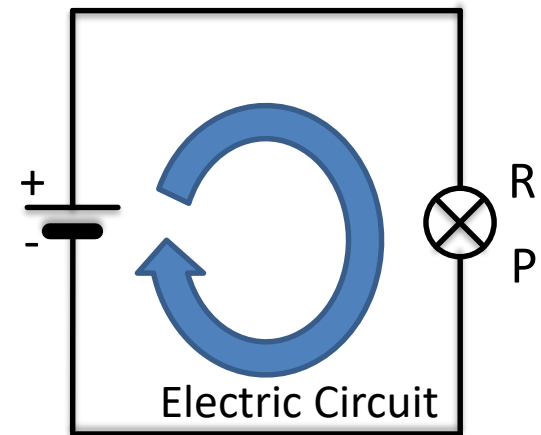
- A load hinders the current
    - Resistance  $R$ , [ $\Omega$ ] (Ohm)

- Power

- A load consumes power
    - Power  $P$ , [ $W$ ] (Watt)

- Formulas

- $R = \frac{V}{I}$ ,  $P = V \cdot I$



# Electric Circuit (4)

- Exercise

- If a voltage of 5 V is applied to a lamp and a current of 20 mA flows through it

- What is the resistance of the lamp?

- $R = \frac{V}{I} = \frac{5 V}{20 mA} = \frac{5 V}{0.02 A} = 250 \Omega$

- What power is consumed?

- $P = V \cdot I = 5 V \cdot 20 mA = 5 V \cdot 0.02 A = 0.1 W$

- $P = 0.1 W = 100 mW$

# Electric Circuit (5)

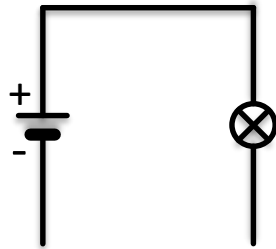
- Rules of Thumb
  - The current flows from plus (+) to minus (-)
  - Current is measured at a point
    - It flows through this point
    - It flows for example through a load
  - Voltage is measured between two points
    - It is applied at these points
    - Often one of these points is ground
      - Ground, GND  $\rightarrow$  0 V

# Electric Circuit (6)

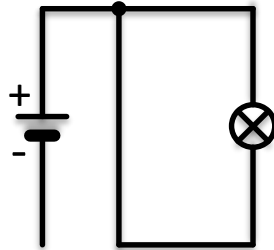
- Rules of Thumb

- Electric Current can flow only if ...

- ... the electric circuit is closed

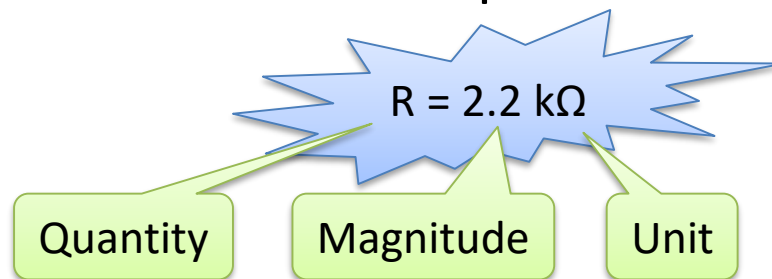


- ... there is a voltage difference



# Unit Prefixes (1)

- Physical quantities
  - Have a magnitude
    - Should not have more than three digits
    - Should not have a decimal point
      - Exception: Circuit Diagrams (e. g. 2k2)
  - Have a unit
    - Prefixes are used to respect these rules

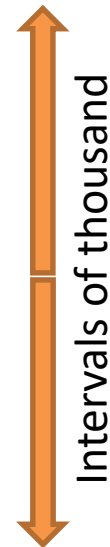




# Unit Prefixes (2)

- Decimal unit prefixes (SI)
  - In technical applications powers of three are used
    - Centi and deci are usually not used

Text	Symbol	Value	Factor	Power
Giga	G	Billion	1 000 000 000	$10^9$
Mega	B	Million	1 000 000	$10^6$
Kilo	k	Thousand	1 000	$10^3$
-	-	One	1	$10^0$
Milli	m	Thousandth	0.001	$10^{-3}$
Micro	$\mu$	Millionth	0.000 001	$10^{-6}$
Nano	n	Billionth	0.000 000 001	$10^{-9}$



# Unit Prefixes (3)

- Binary unit prefixes (IEC)
  - One uses powers of 1024
    - $2^{10} = 1024 \rightarrow$  Quite close to 1000
  - There are texts and symbols of it's own
    - But they are seldom used

Text	Symbol	Factor	Power	Power
Gibi	Gi	1 073 741 824	$1024^3$	$2^{30}$
Mebi	Mi	1 048 576	$1024^2$	$2^{20}$
Kibi	Ki	1 024	$1024^1$	$2^{10}$
-	-	1	$1024^0$	$2^0$