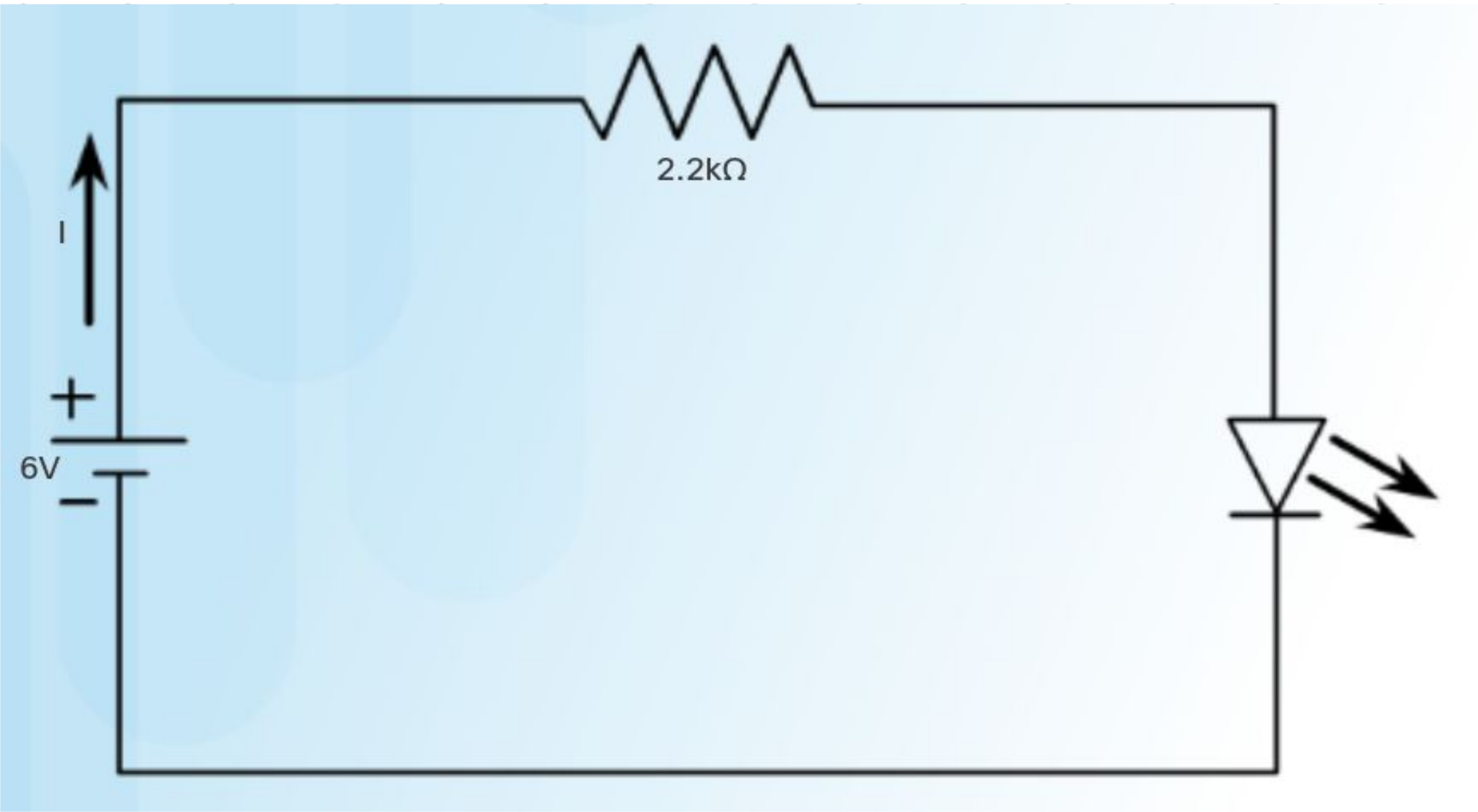
Electronics

Basic Electrical Circuit

Circuit Diagram (schematic)

Conventional Current direction



- **Electronic devices** all share a fine level of control of **electrical energy**
  - This control happens through the **electronic circuit**

- To create an **electric current** the circuit also needs an **electrical energy** source
  - like a battery to start the flow of electricity

Circuits

- **`Closed Circuit`**
  - allows current to flow
- **`Open Circuit`**
  - has a break in the pathway which stops the current from flowing
  - can be created by placing an on/off switch along the circuit pathway
- **`Short Circuit`**
  - is usually not created by design
  - happens when unintended connection between 2 points bypass normal pathway

Short Circuit Causes:

- too much current to overload components
  - Electrical current normally takes the path of least resistance
- overheating
- unsafe scenarios
  - melting wires
  - component failure
  - possibility of electrical fire

Electronic Components

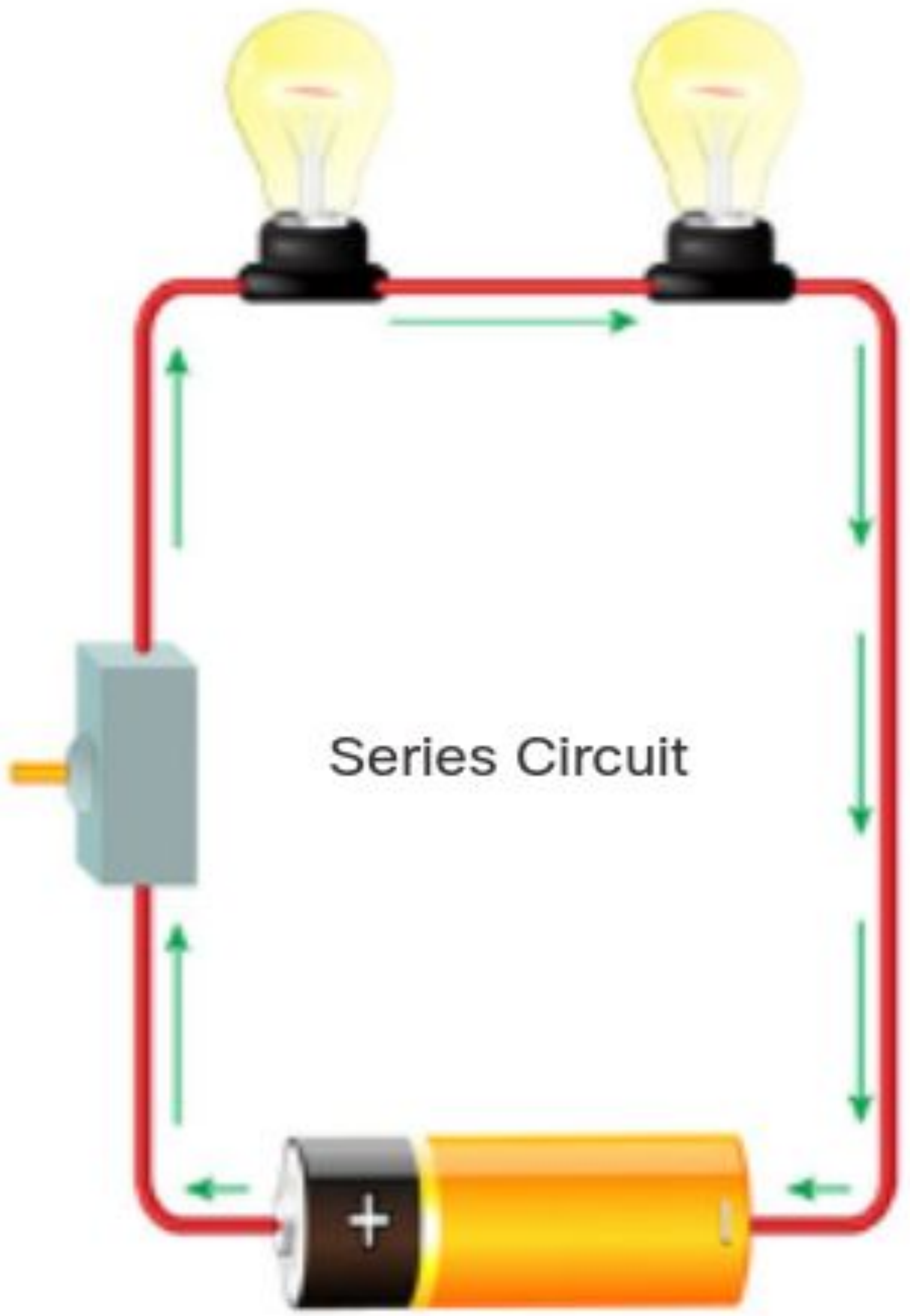
Capacitor

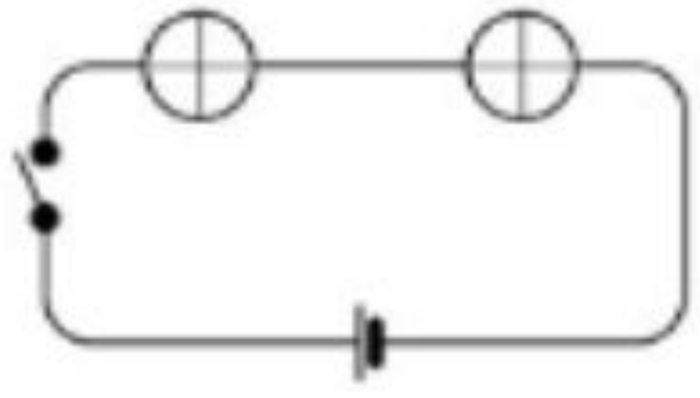
Resistor

- are usually made with **Leads**
- **Leads** are protruding wires that
  - connect to the inside of the component
  - provide the means to connect the component to other circuit elements

Series Circuit

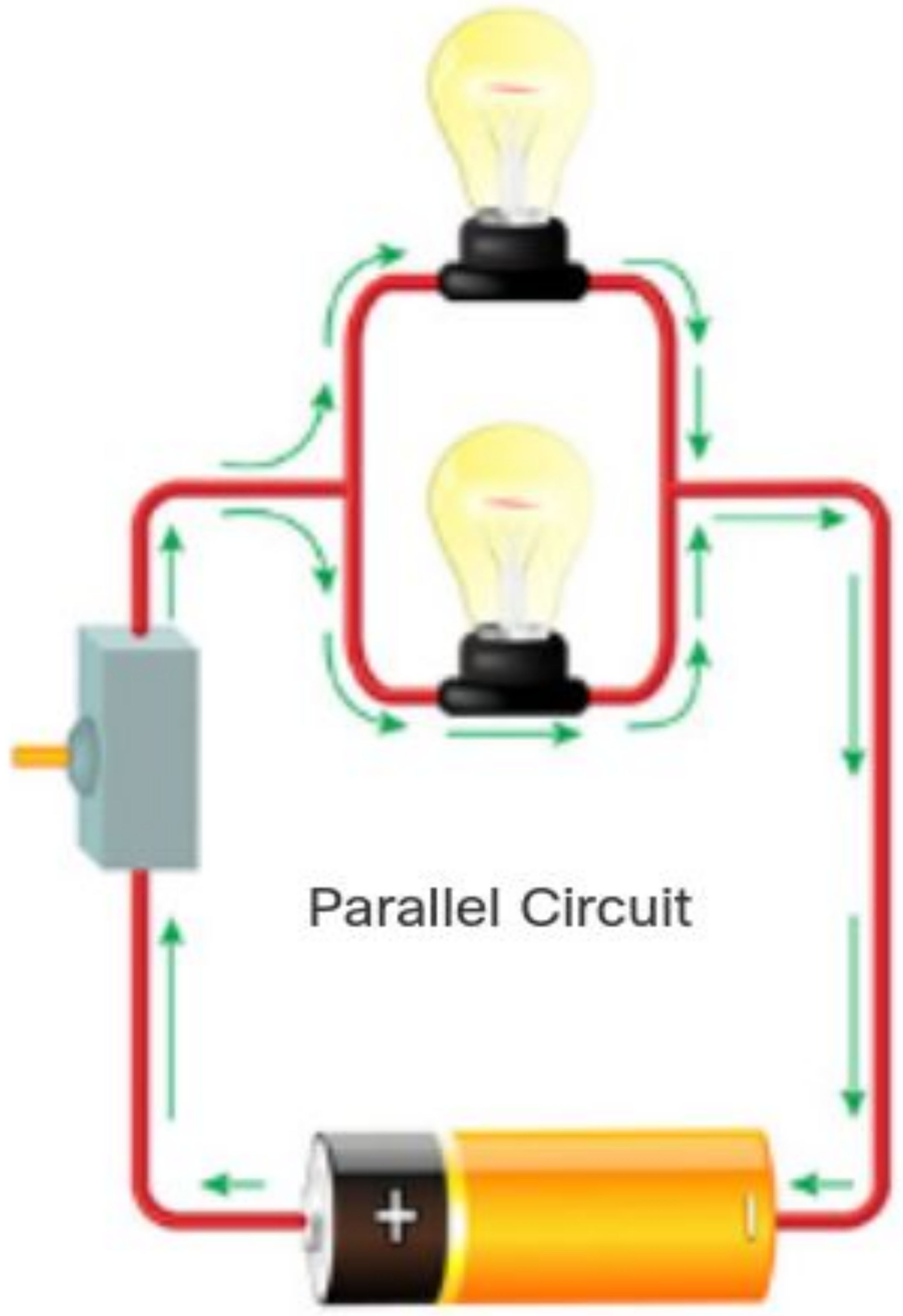
- Components are interconnected one after another
- **Current** travels through each component in a linear fashion
- **Example:** string of decorative holiday lights

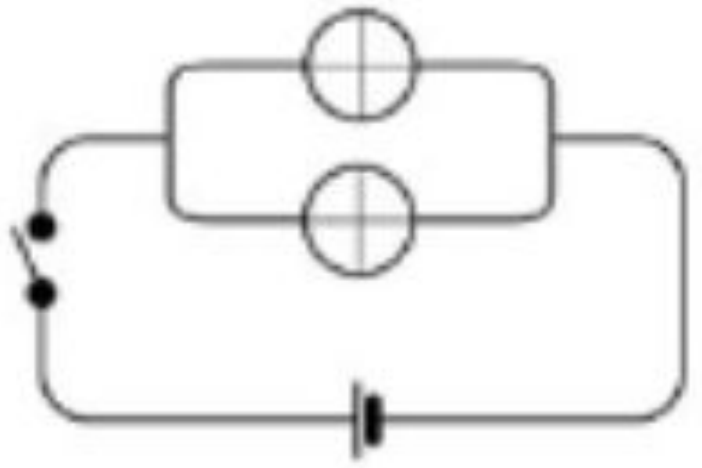




Parallel Circuit (1/2)

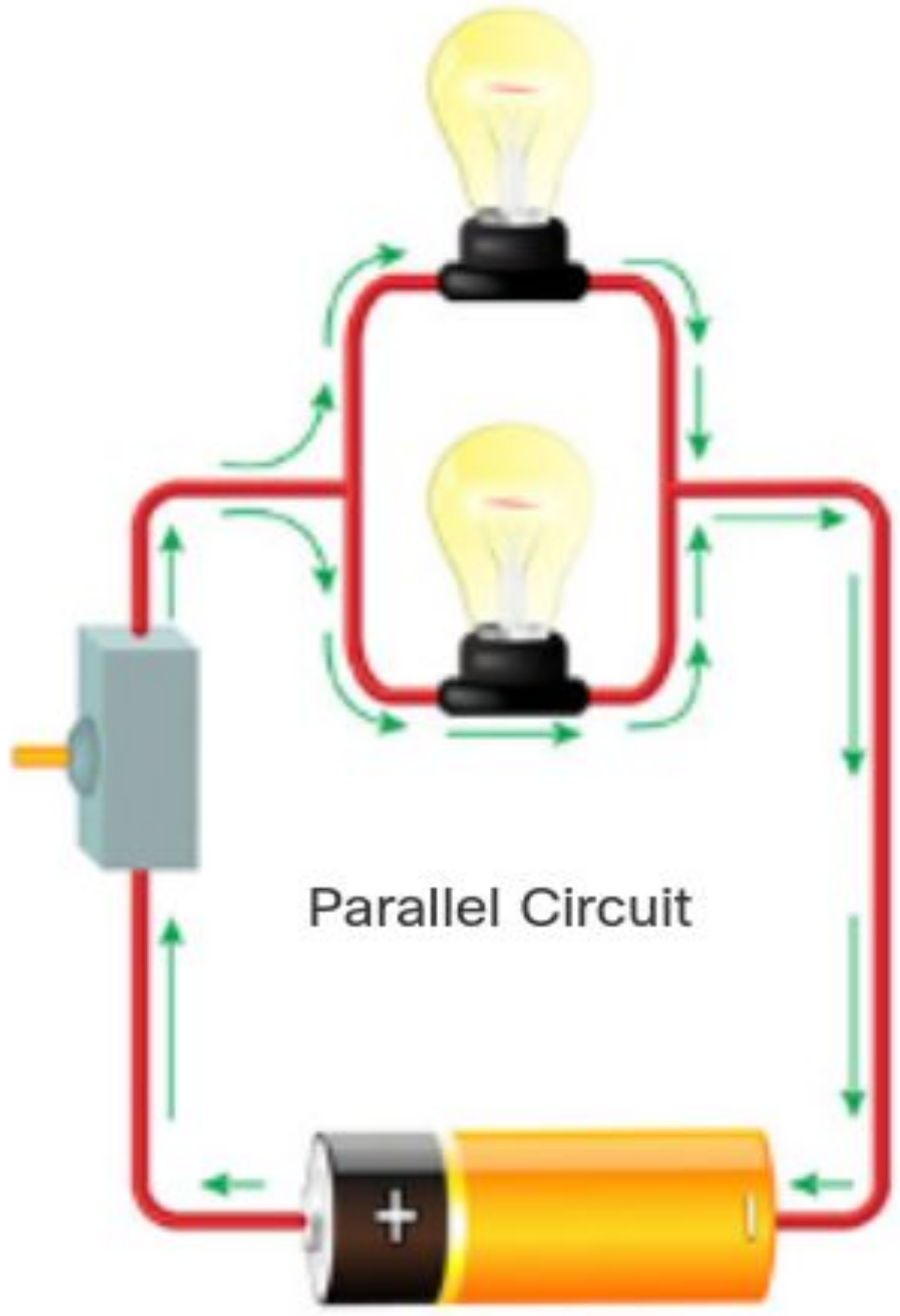
- Current splits at a **junction** which leads to parallel pathways
- Components connected along each pathway
- Solve the common problem of a holiday string of lights

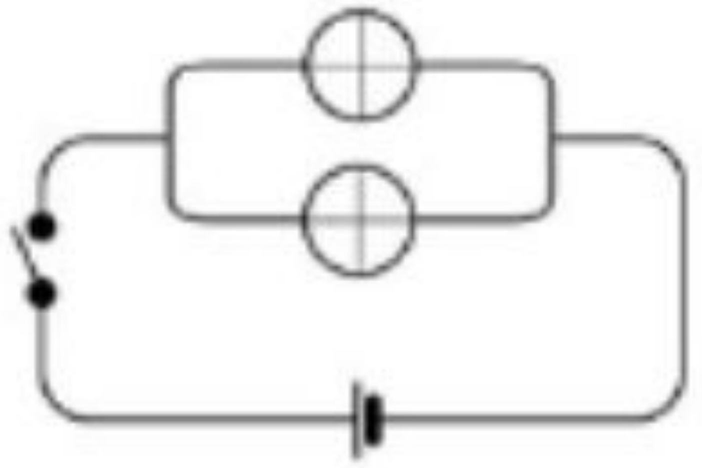




Parallel Circuit (2/2)

- You can power multiple components (like LEDs)
- Each component gets its own supply of current
- If any component were to fail, it would not stop the current from:
  - flowing to the other pathways
  - powering the other components





Notes

Series or Parallel Circuits?

- decision depends on the application

Power Supply

- must be **powerful** enough to provide **power** to the entire circuit (series or parallel)

Electrical Device

- with switch creates circuit that can be closed or opened

Passive Examples

Passive Component Examples

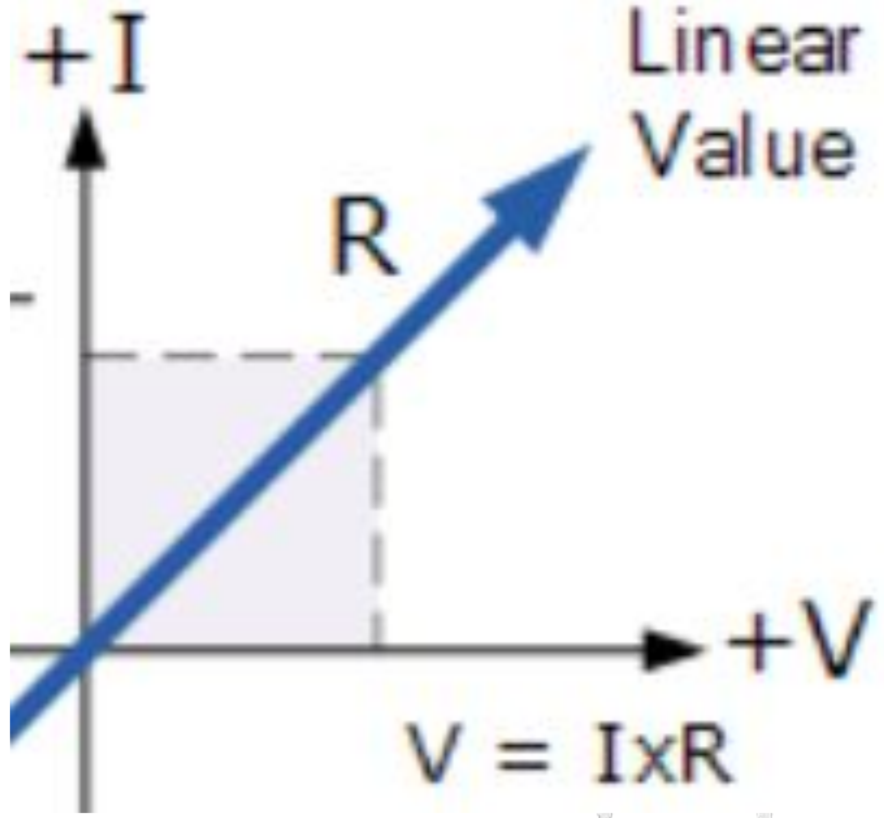
- Resistors
- Capacitors
- Inductors
- Transformers

Linear Circuits Examples

- Amplifiers
- Differentiators
- Integrators
- Linear Electronic Filters

Passive Components

- electronic components that maintain/**store energy** and create **linear circuits**
- are incapable of controlling **electric current** by means of another electrical signal
- cannot introduce **energy** into a circuit
- cannot rely on a source of power
  - except for what is available to them from the circuit they are connected to
- cannot amplify the **power** of a signal
  - although they may increase the voltage or current



Active Examples

Active Component Examples

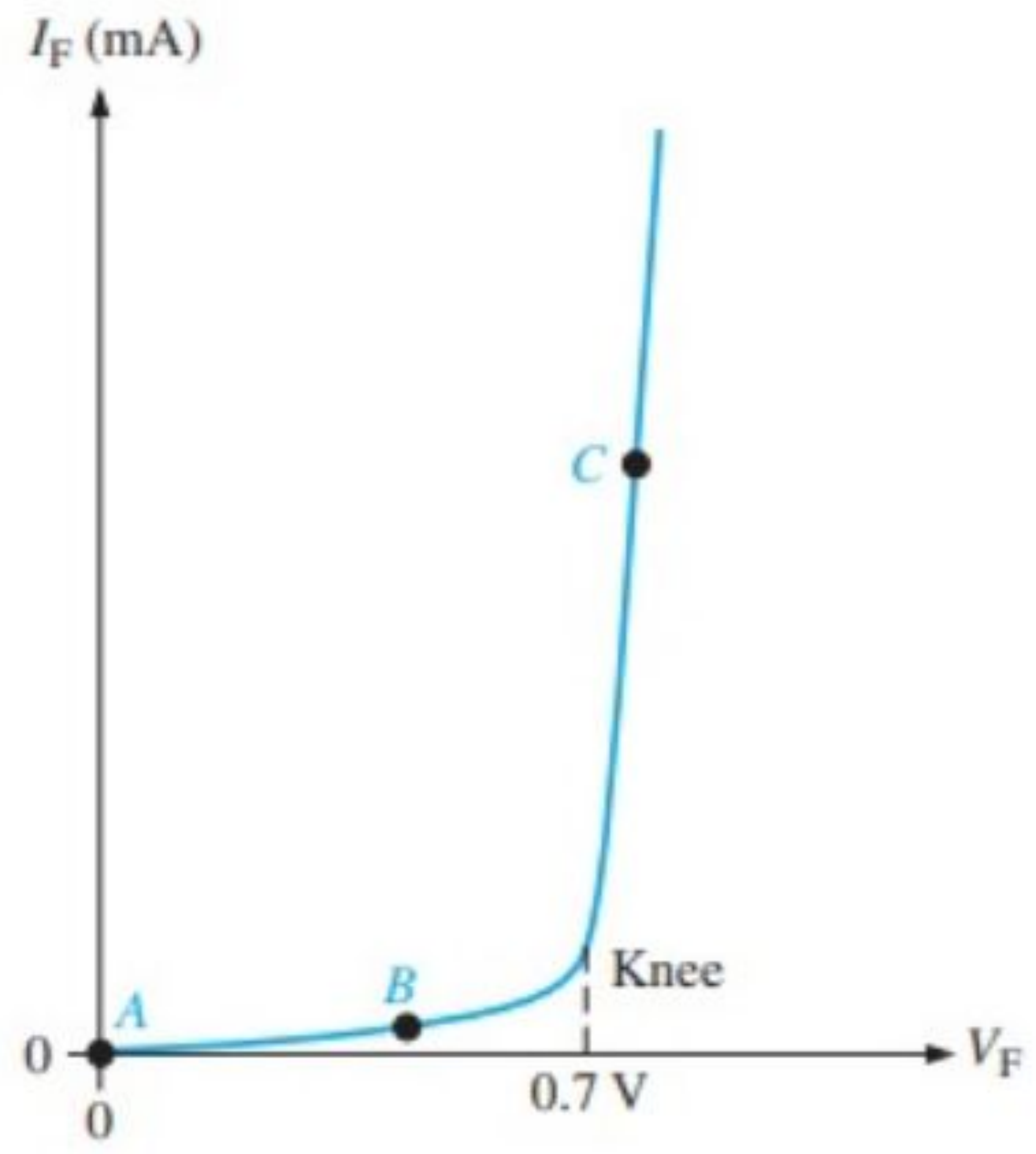
- Diodes
- Transistors
- Silicon Controlled Rectifiers (SCRs)

Nonlinear Circuits Examples

- Mixers
- Modulators
- Digital Logic Circuits

Active Components

- Electronic components that **produce energy** and create **nonlinear circuits**
- can control **electric current** with an external source of energy
- provide power gain or amplification that produces voltage signaling that is **discontinuous (nonlinear)**



Circuits

- **Passive Circuit**
  - An electronic circuit consisting entirely of passive components

- **Active Circuit**
  - is a circuit with at least one **Active Component**

Linear Circuit

- has no **nonlinear components**

- in it, the values of the **electronic components** (resistors, capacitors, inductors ...)
  - do not change with the level of voltage or current in the circuit

- are important because
  - they can amplify and process electronic signals without distortion

- **Example** of electronic device that uses **linear circuits** is a sound system

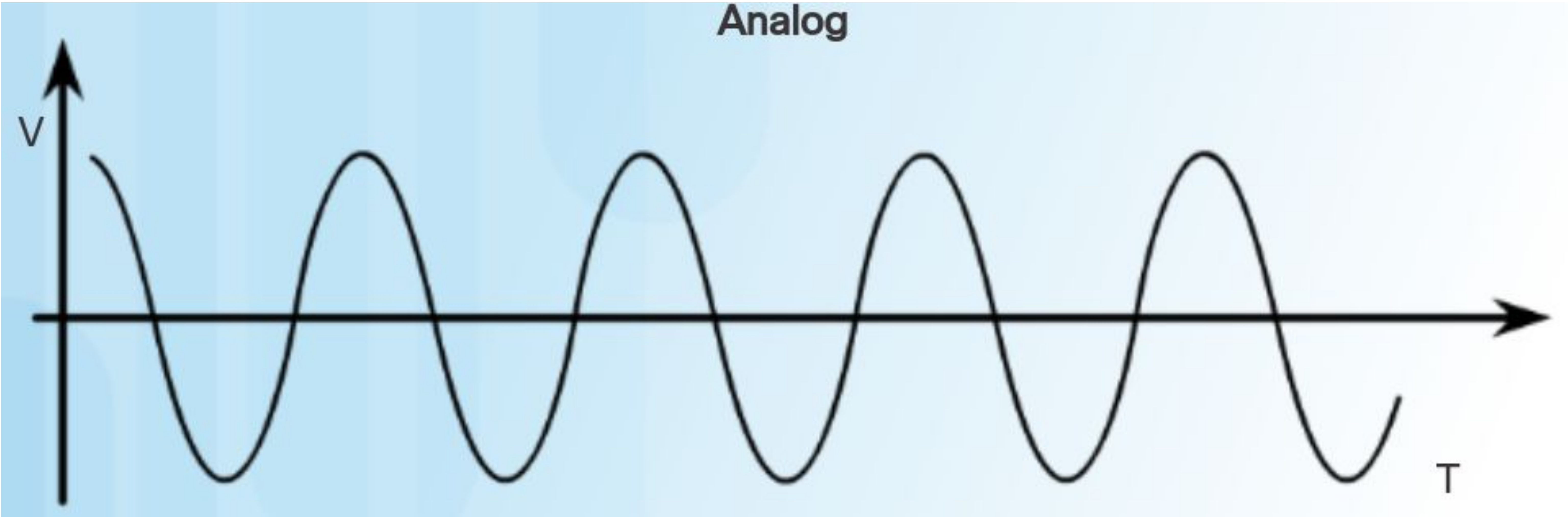
Circuits

- **Analog Circuits**
  - present a **contiguous signaling**
  - can assume any value between no power to full power
- **Digital Circuits**
  - present a **discrete signaling**
  - can assume either no power or full power → no intermediate steps

Analog Circuits

- in it, current or voltage may vary **continuously** with time to correspond to the information being represented

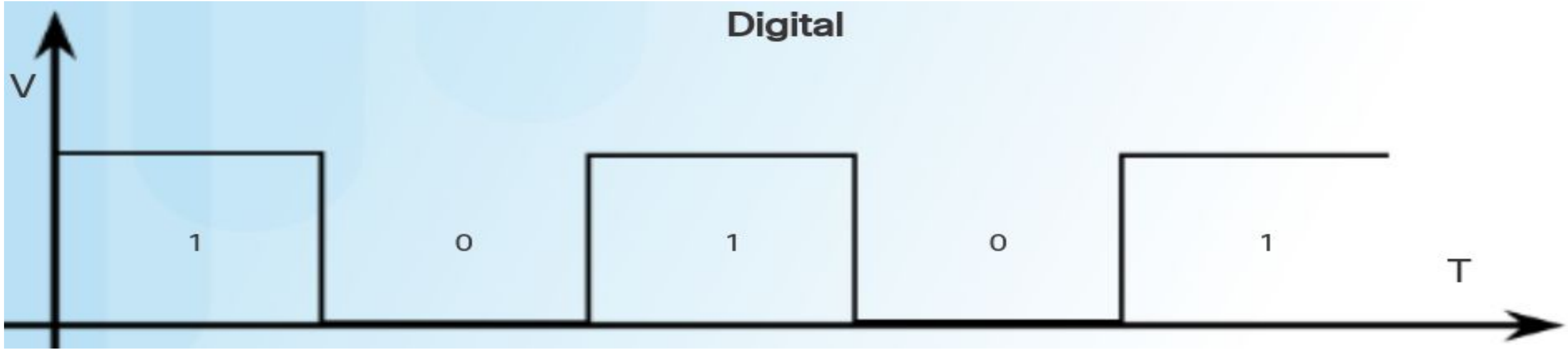
- used in power management circuits, **sensors**, amplifiers, and filters



Digital Circuits (1/2)

- have electric signals that
  - take on two discrete **values** corresponding to the level of voltage

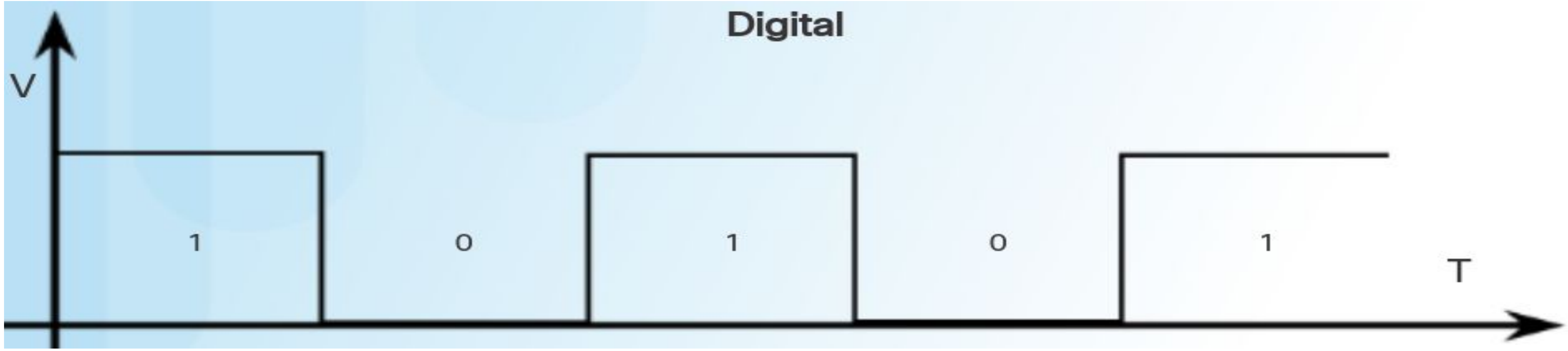
- These **values** are binary and are represented as 1/0, on/off, or high/low



Digital Circuits (2/2)

- In it, binary encoding is used:
  - one voltage represents a binary 1
  - another voltage represents a binary 0 (value near the ground potential or 0 volts)

- can be designed to provide both logic and memory by:
  - interconnecting these binary signals,
  - enabling them to perform arbitrary computational functions



Direct Current (DC)

- Type of current in which the flow of electrons goes one way only

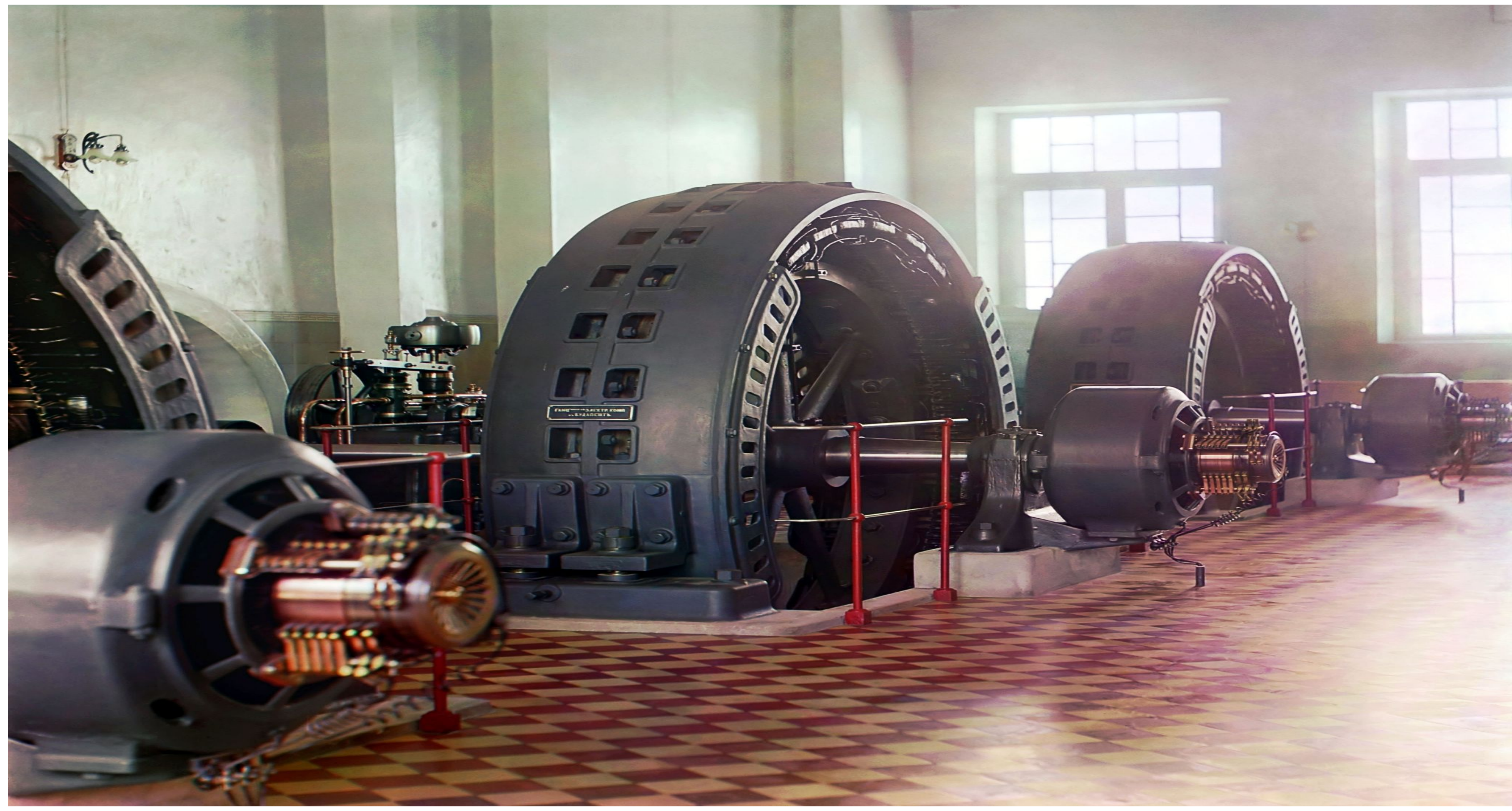
- Produced by sources like batteries, power supplies, solar cells, or dynamos
- Used to charge batteries and as power supply for electronic systems

- can be obtained from **AC** by using a **Rectifier** to convert **AC** into **DC**
  - **Rectifiers** force current to flow in one direction only
  - **Rectifiers** are commonly found in an AC to DC power supply

Alternating Current (AC) (1/2)

- its flow of electric current periodically reverses direction
- is the form in which electric power is delivered to businesses and residences
- its usual waveform of in most electric power circuits is sine wave
  - Also, different waveforms are used like triangular or square waves

Alternating Current (AC) (2/2)



- is produced in the electrical power plant by taking advantage of various forms of **mechanical energy** to move large scale **Alternators**
  - **mechanical energy** like water flowing from a dam or the spin of a wind turbine
  - **Alternators** then transform the mechanical energy into electricity

- **DC** produced by a solar plant may be converted into **AC** with an **inverter** or a **motor-generator set**

Questions