Unit 1. Introduction

Digital Electronic Circuits
(Circuitos Electrónicos Digitales)
E.T.S.I. Informática
Universidad de Sevilla

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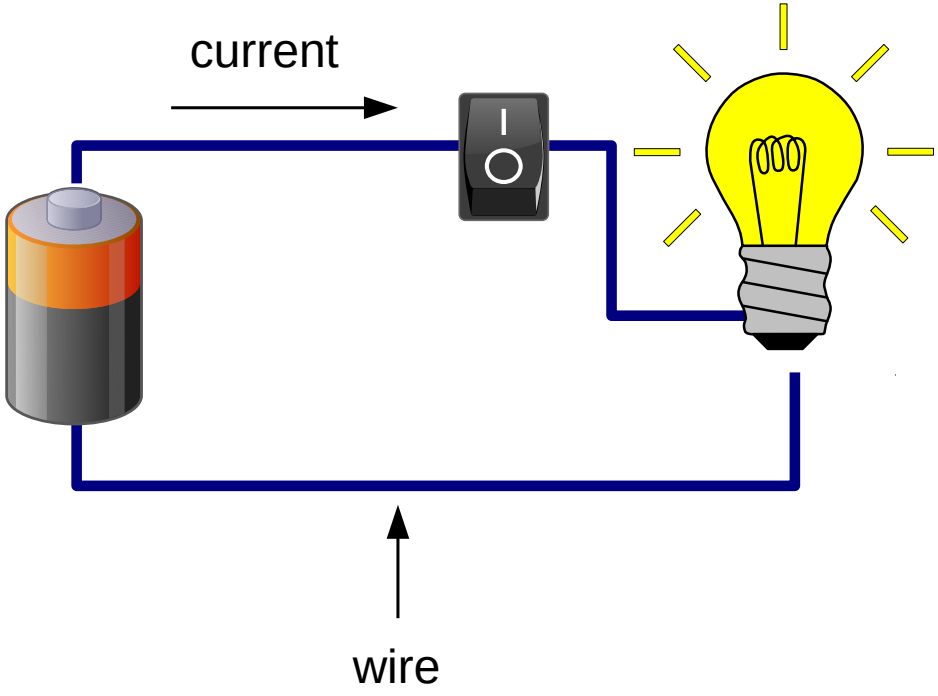
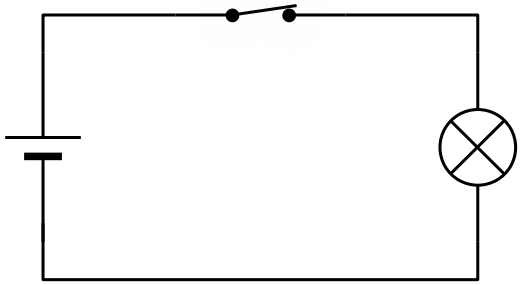
Contents

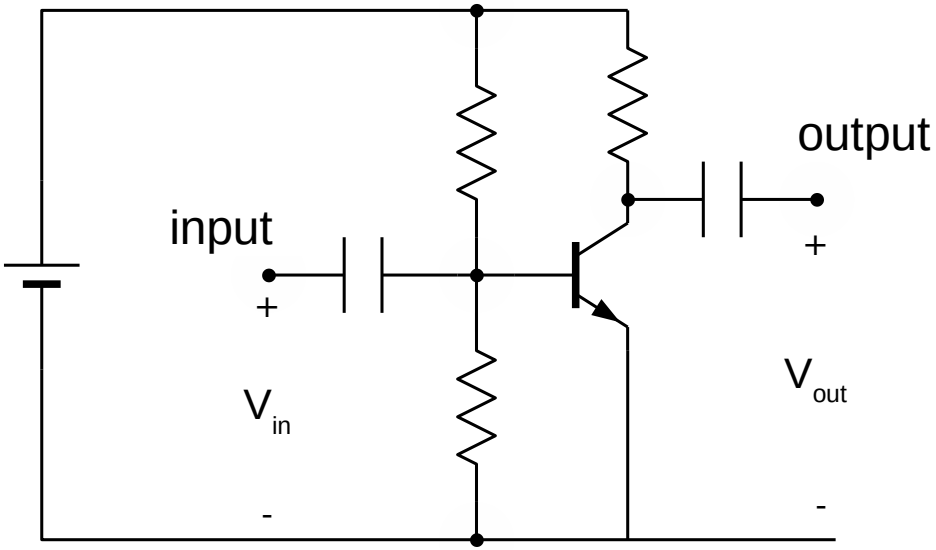
- Digital Electronic Circuits (DEC)
- Analog vs Digital
- DEC and computer curricula
- Practical Course's information

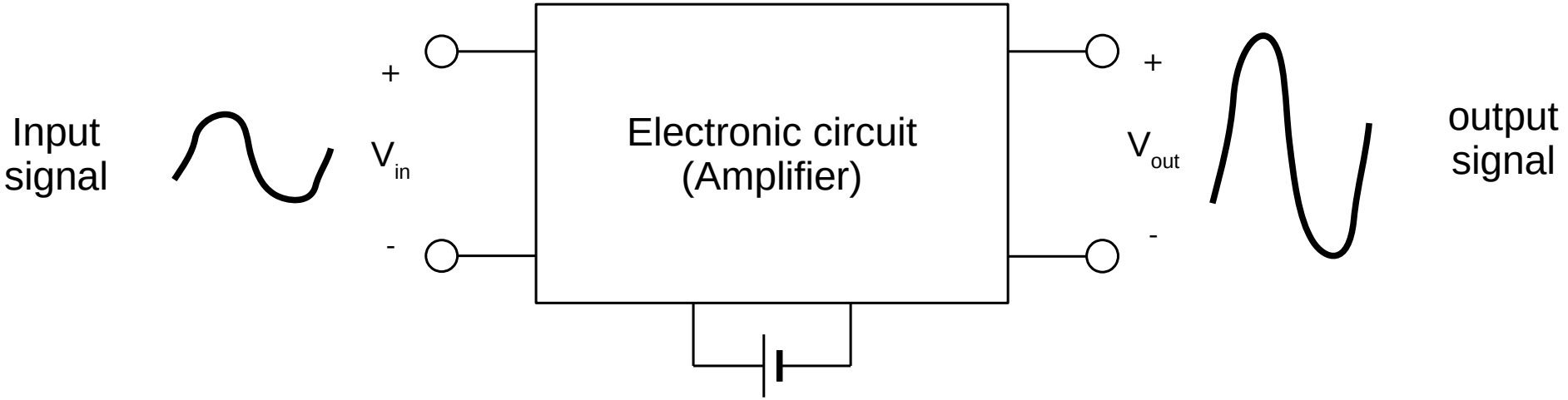
Electric circuits



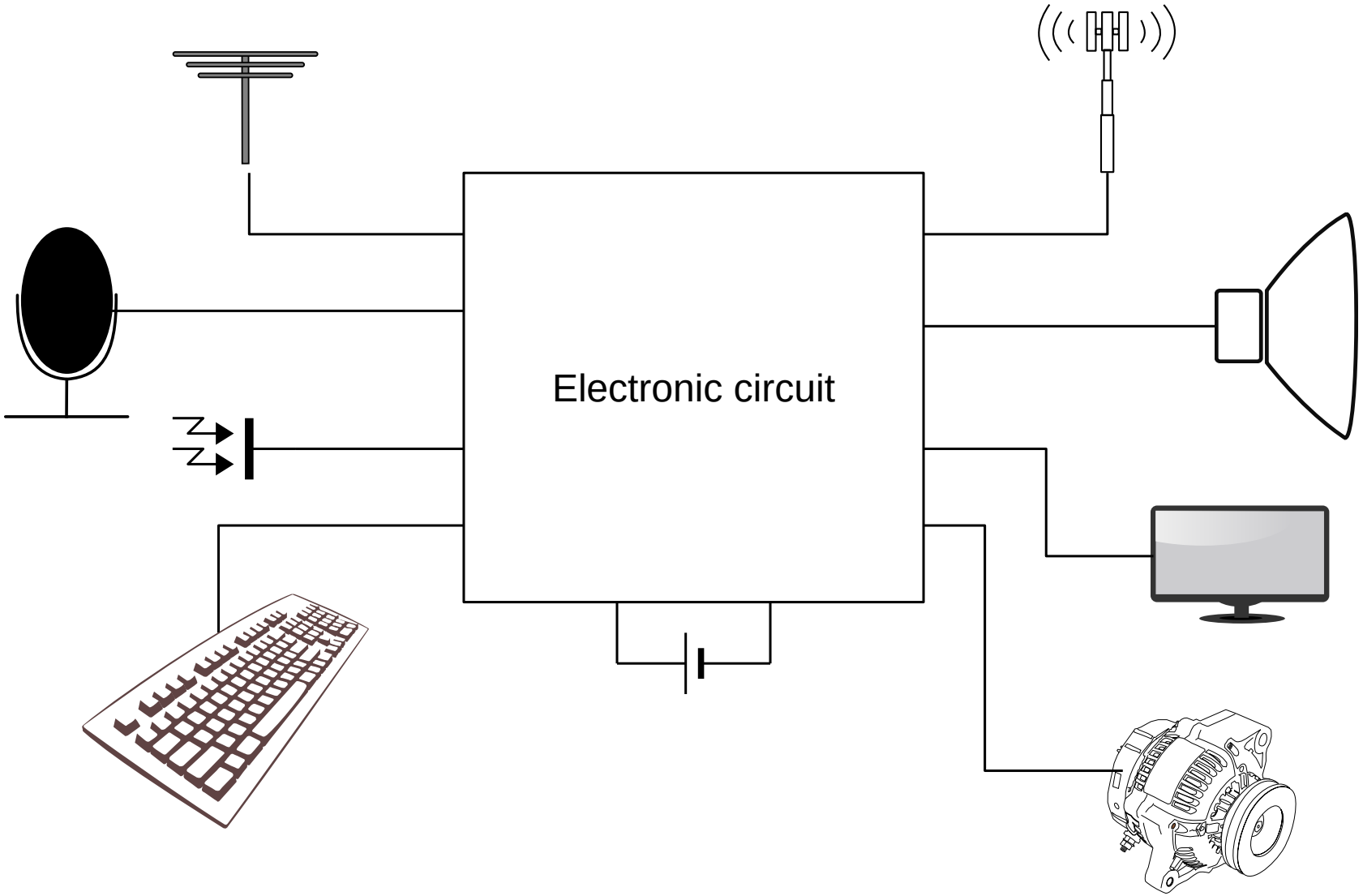


Electronic circuits

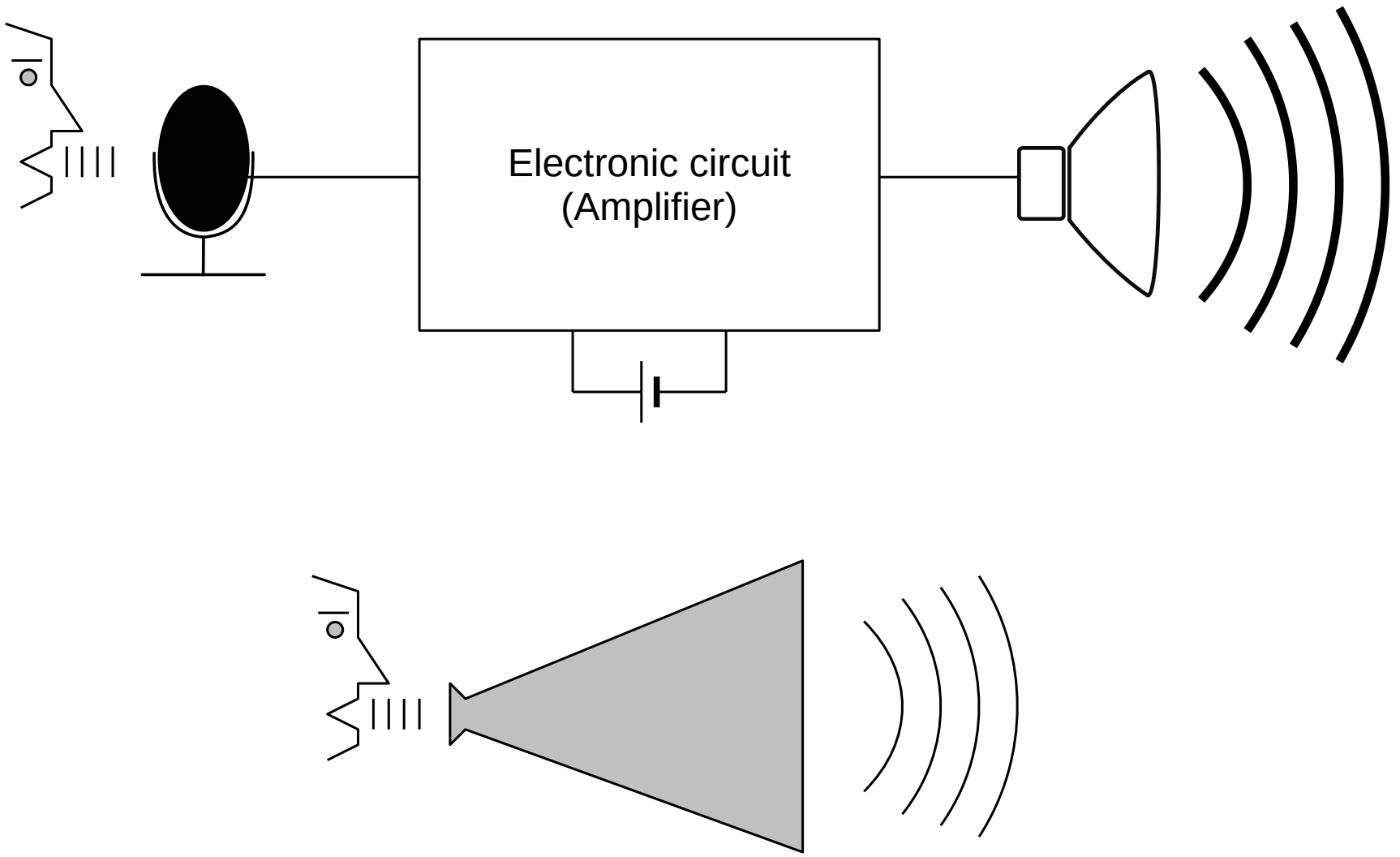




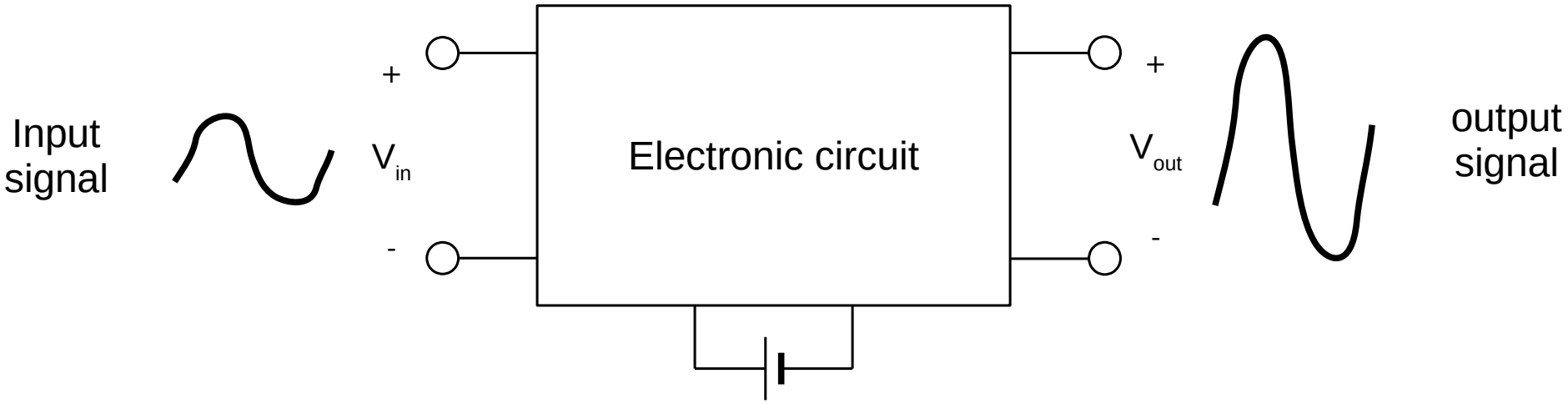
Electronic circuits. Transducers



Electronic circuits. Example

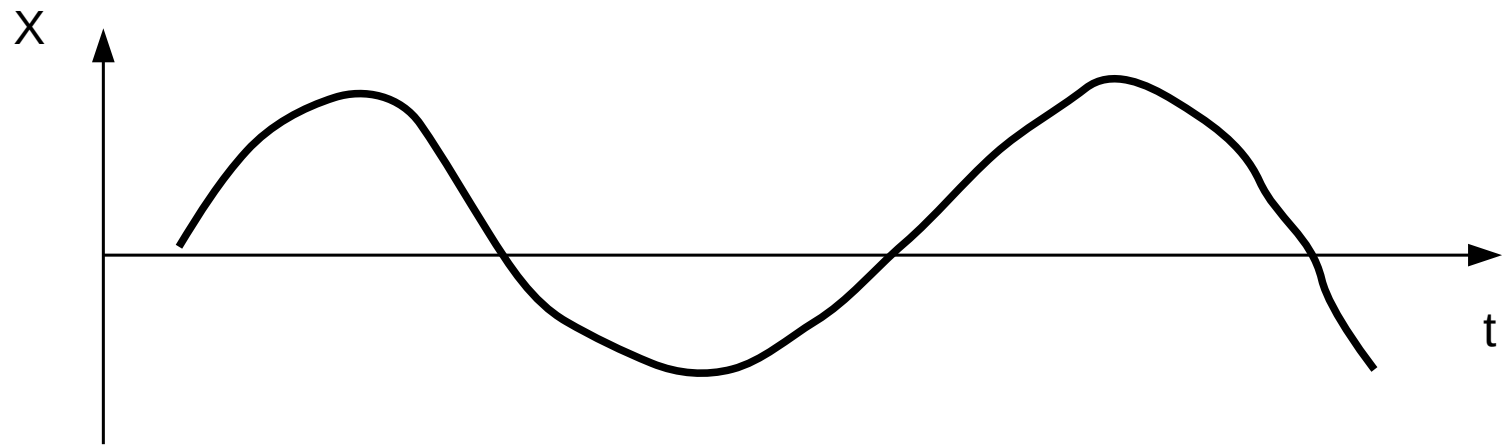


Analog vs Digital



Analog

- Analog signals
  - Continuous in time
  - Can take any value in a given range

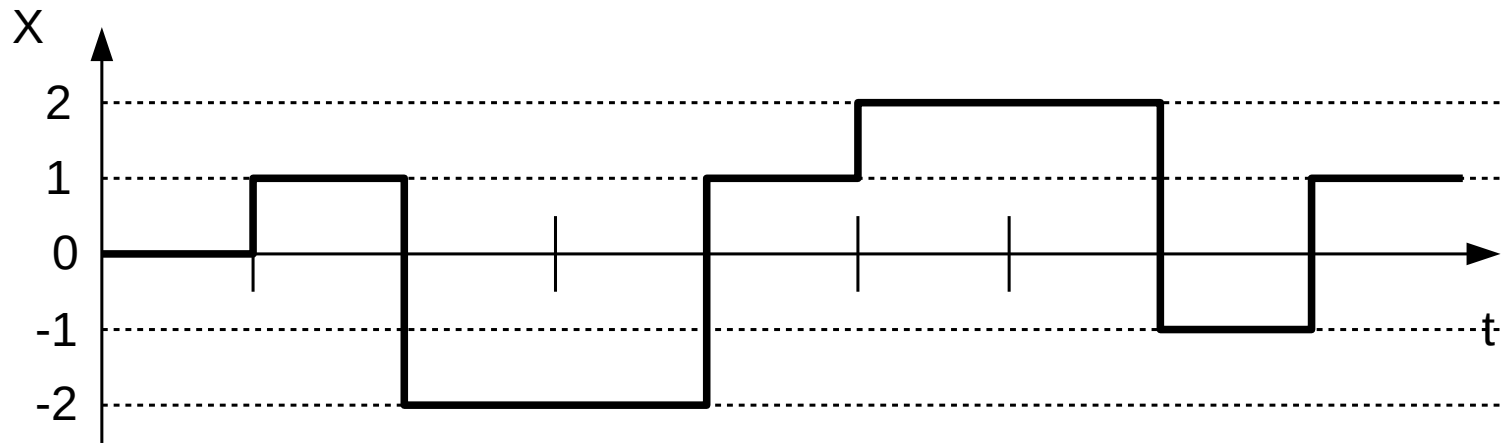


Analog

- Analog signals
  - Come from the nature: light, sound, temperature, ...
  - Transducer circuits convert natural magnitudes in electrical signals: microphones, speakers, photodiodes, antennas, ...
- Analog electronic circuits
  - Process analog signals: amplifiers, filters, ...

Digital

- Digital signals
  - Change at specific times (discrete in time).
  - Only take a finite number of values (discrete values).
  - Can be represented by a sequence of numbers.

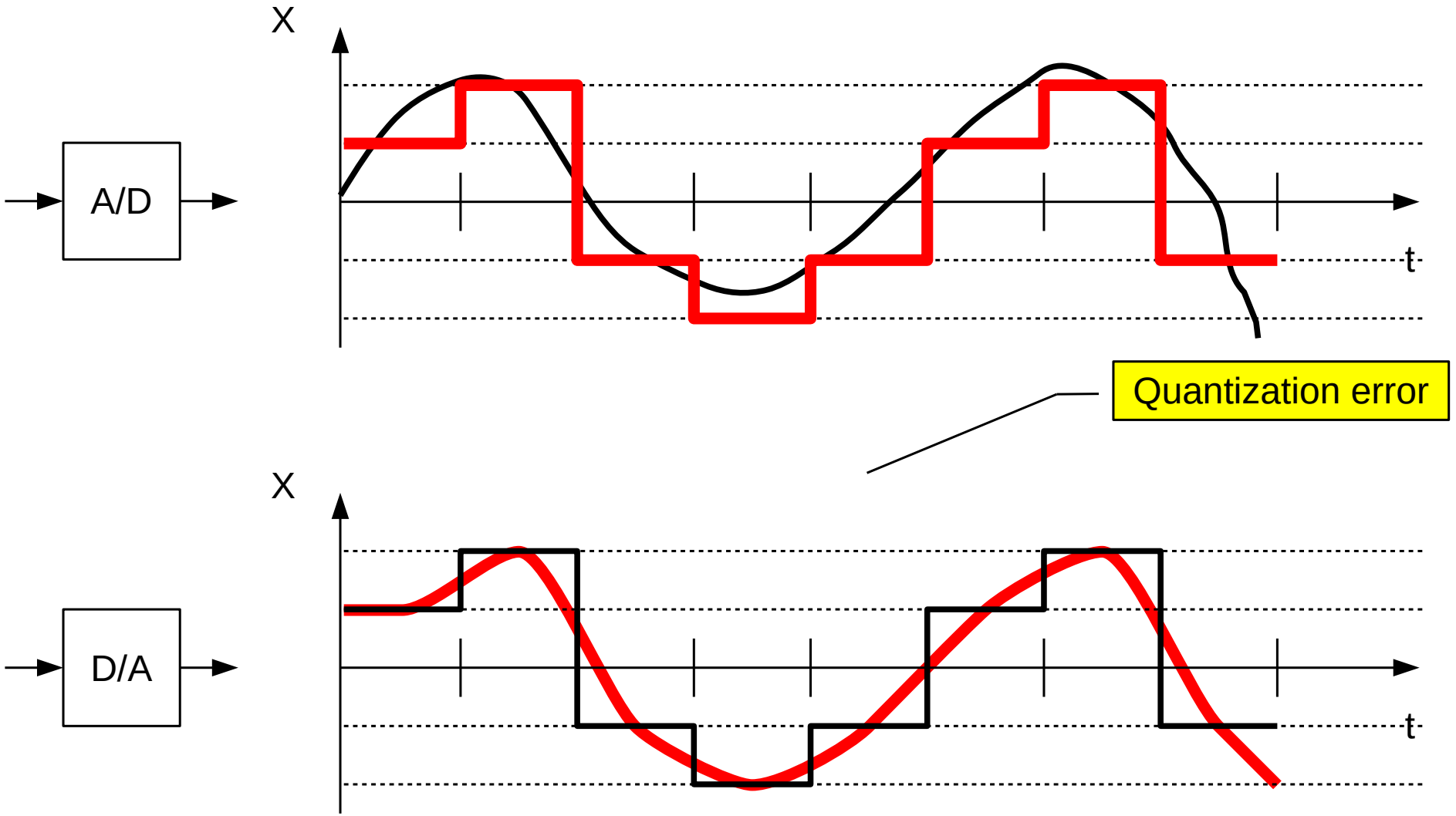


Sequence: 0, 1, -2, -2, 1, 2, 2, -1, 1

Digital

- Digital signals
  - Obtained from conversion from analog signals through analog-to-digital (A/D) converters.
  - Allow a numeric treatment of information.
- Digital electronic circuits
  - Process digital signals by operating with numerical data represented by one or more digital signals.
    - Addition, product, storing, …
  - I some cases, the numerical data generated by digital circuits is converted to analog form by digital-to-analog (D/A) converters.
    - Digital audio/video, etc.

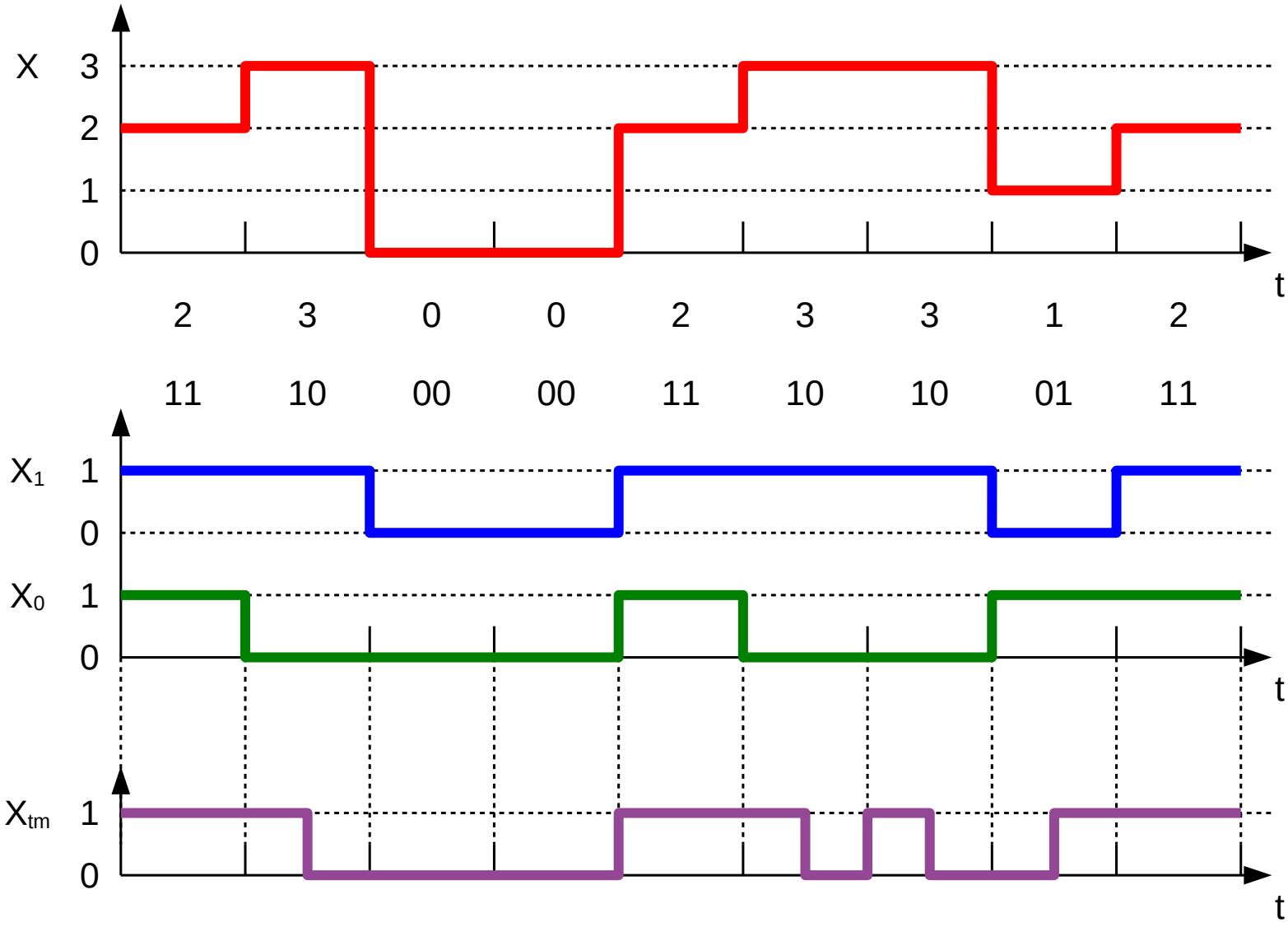
A/D and D/A conversion



Binary digital signals

- **Binary digital signals** only take two values, commonly noted as “0” and “1”.
  - This is where all the 0's and 1's fuzz comes from.
- **Multi-valued digital signals** can be equivalently represented by binary digital signals easily.
- In most cases, we use binary digital signals for convenience (more on this in the next unit).

Binary digital signal

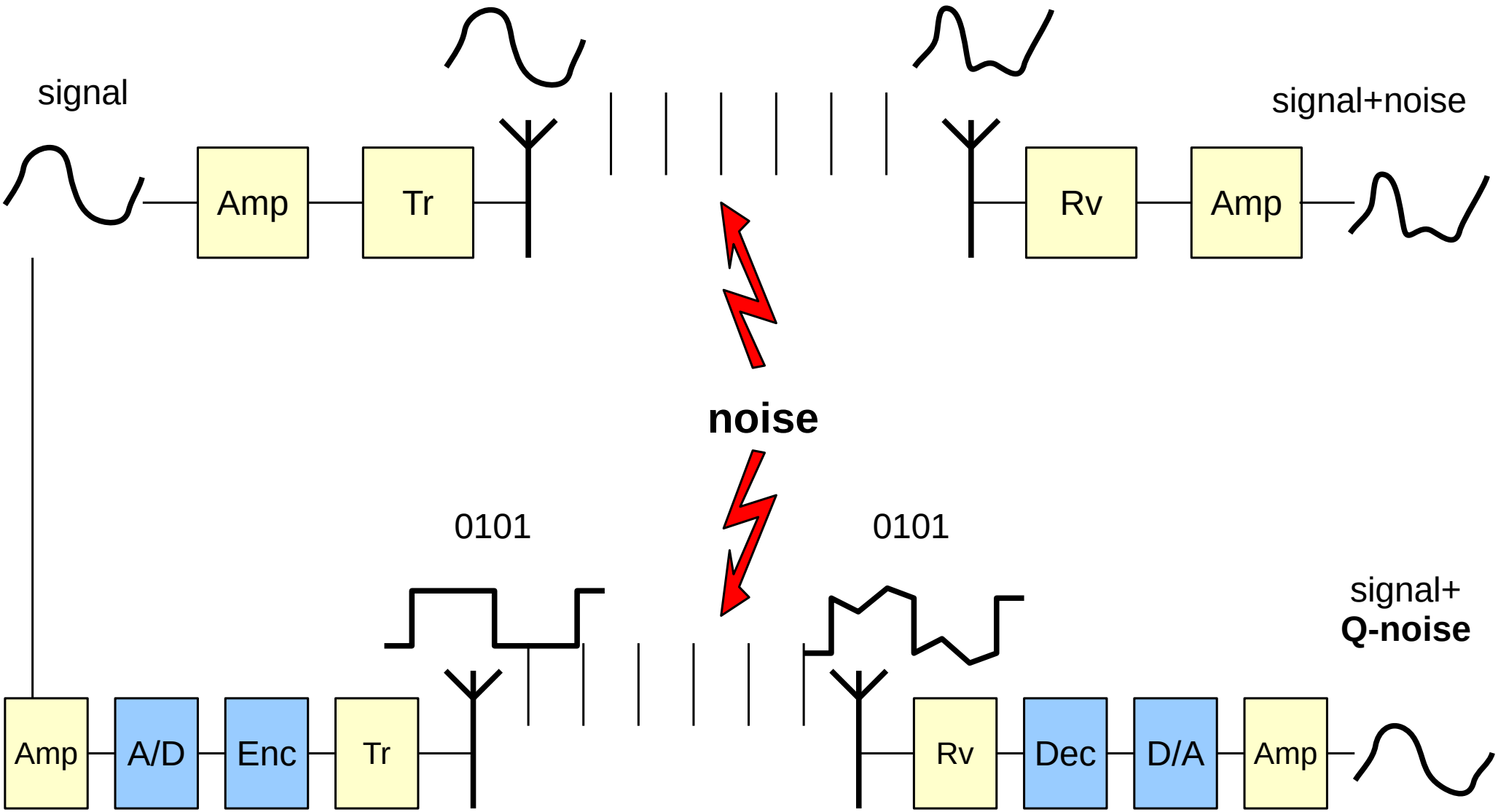


One multi-valued digital signal.

Two binary digital signals.

One time-multiplexed binary digital signal.

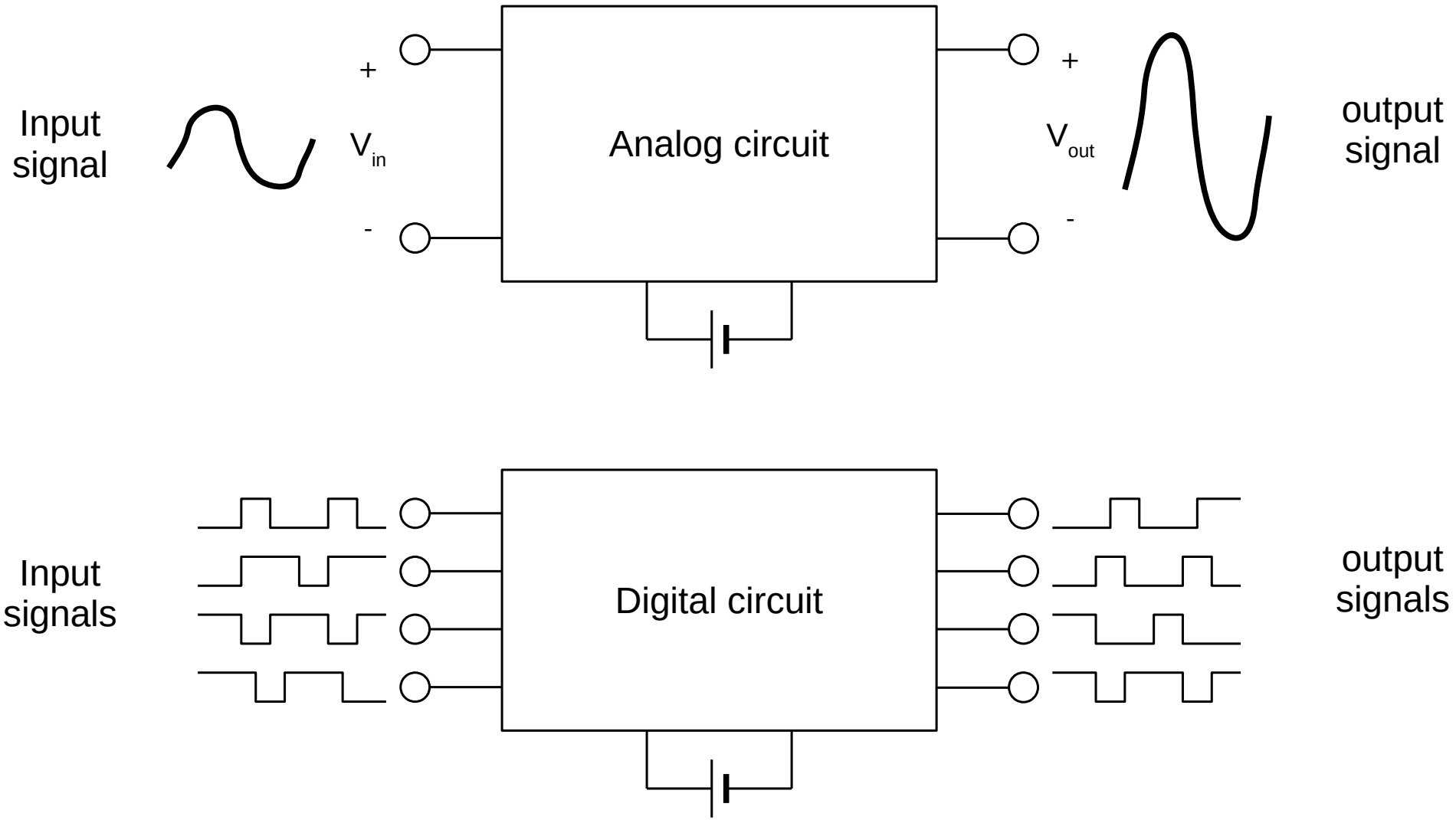
E.g.: analog vs digital transmission



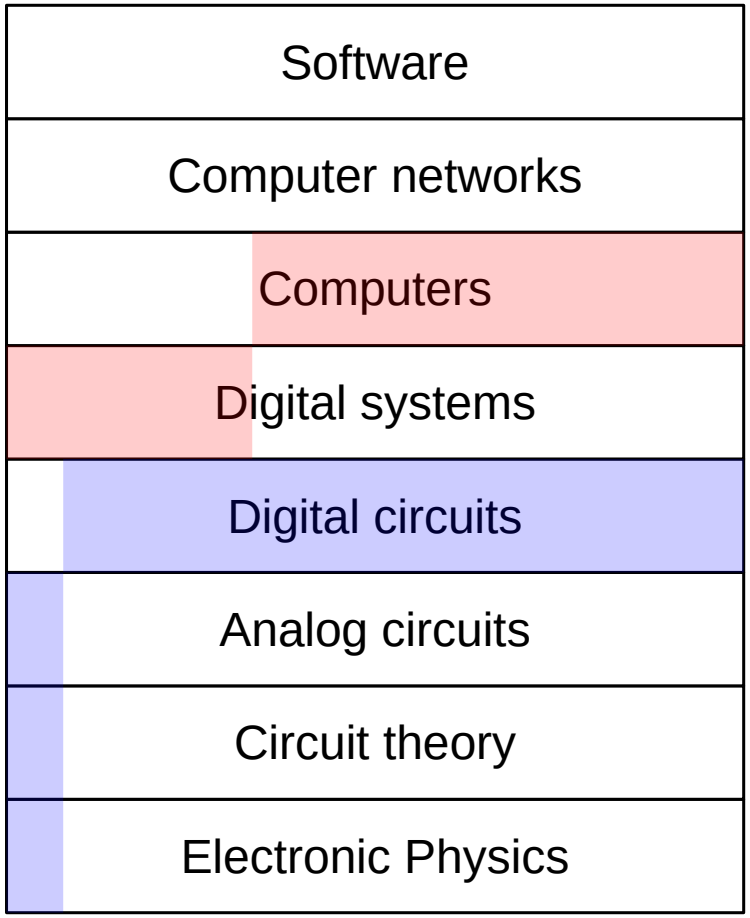
Digital vs Analog

- Drawbacks
  - Slow processing compared to analog
  - Bigger circuits
  - Higher power consumption
  - A/D and D/A requiered
  - Quantization error
- Advantages
  - Much easier design and implementation
  - Transmission without loss of quality
  - Much more powerful processing
    - Compression, error detection/correction, storage, etc.
  - Homogeneous treatment of information:
    - sound, image, text, etc.

Digital vs Analog



DEC and computer curricula



Computer Structure (EdC)

Digital Electronic Circuits (CED)

Summary

- Electronic circuits (electronic technology) is a convenient way to solve many practical problems:
  - Detect objects and events
  - Process control
  - Signal broadcasting and processing
  - …
- Digital electronics simplifies and allow further applications:
  - Complex data processing
  - Complex control algorithms
  - Easy and reliable data storage
  - …
- Digital electronic technology builds the hardware where software is executed

Practical information

- Teaching staff
- Digital electronics
- Program
- Activities
- Methodology
- Calendar
- Assessment (evaluation)
- Resources

Teaching Staff

- Jorge Juan-Chico (me)
  - Theory and practical session
- David Guerrero Martos
  - Laboratories

Program

- Part 1: Electronic circuits and logic families
  - 1. Introduction
  - 1.5. Electronic circuits and logic families
  - 2. Digital encoding
- Part 2: Combinational applications
  - 3. Combinational circuits
  - 3.5. Hardware description languages
  - 4. Combinational subsystems
  - 5. Arithmetic and logic units
- Part 3: Sequential applications
  - 6. Synchronous sequential circuits
  - 7. Sequential subsystems

Activities

- On-site/on-line (~60 hours, 4 h/week)
  - Theory sessions: concepts, examples, short tests.
  - Practical sessions: problem solving.
  - Laboratory sessions: actual implementations
  - Quizes, tests
- Off-site (~90 hours, 6 h/week)
  - Study
  - Problem solving
  - Laboratory preparation
- Tutorship
  - On-site/on-line: see instructor's web page

Methodology

- Theory sessions
  - The instructor explains theory concepts and problem solving methods using practical examples
  - Proposes an assignment (key exercises).
  - Proposes additional exercises from the course's collection.
- Personal (including group) work
  - Learn the theory and methods. Try to solve the assignment NOT watching other year's solutions. Ask the prof. for assistance.
- Practical sessions
  - Students ask questions about assignments or other problems.
  - Prof. gives guidance so that students finish their assignment.
- Labs
  - Students read the lab exercise an do the pre-lab work.
  - Sample circuits are implemented in lab sessions.

Assessment

- In-course (continuous) assessment
  - Theory and problems (80%)
    - Two blocks: combinational, sequential
    - Short quizzes with every unit (20%)
    - Two partial tests (80%) one block each
  - Labs (20%)
    - Mandatory (may skip just one)
  - Must pass both
- Final exams
  - Theory and problem exam (80%)
    - May take only the failed block during in-course assignment
  - Lab exam (20%)
  - Must pass both
  - Marks from in-course assignment are kept up to the 3rd official call

Resources

- US Virtual Teaching platform (EV) (ev.us.es)
  - Everything should be there
- Department's web page (www.dte.us.es)
  - Instructor’s web pages (office hours, e-mails, etc.)
  - Course’s backup page (in case EV go nuts)
    - Basic emergency information
- ETSII web page (www.informatica.us.es)
  - Class place and dates, exam dates, covid-19 info, etc.
- Communication
  - Official: E-mail through EV.
  - Others: check EV and web page.

You must read the Syllabus (in EV)