# IoT hardware (in Simulation)

## Internet of Things

UTEC
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**CS5055 – 2025-I**
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# Executive Summary



- **Motivation:** IoT needs a hardware component.
- **Problem:** We need to understand the importance and basic physics of the hardware component of IoT
- **Overview:**
- SimulIDE Simulator
- Review of IoT fundamentals and computing systems.
- **Conclusion: Circuit components and overall hardware components can effectively model an IoT systems.**

# Outline



Circuit Elements

Microprocessors and Microcontrollers

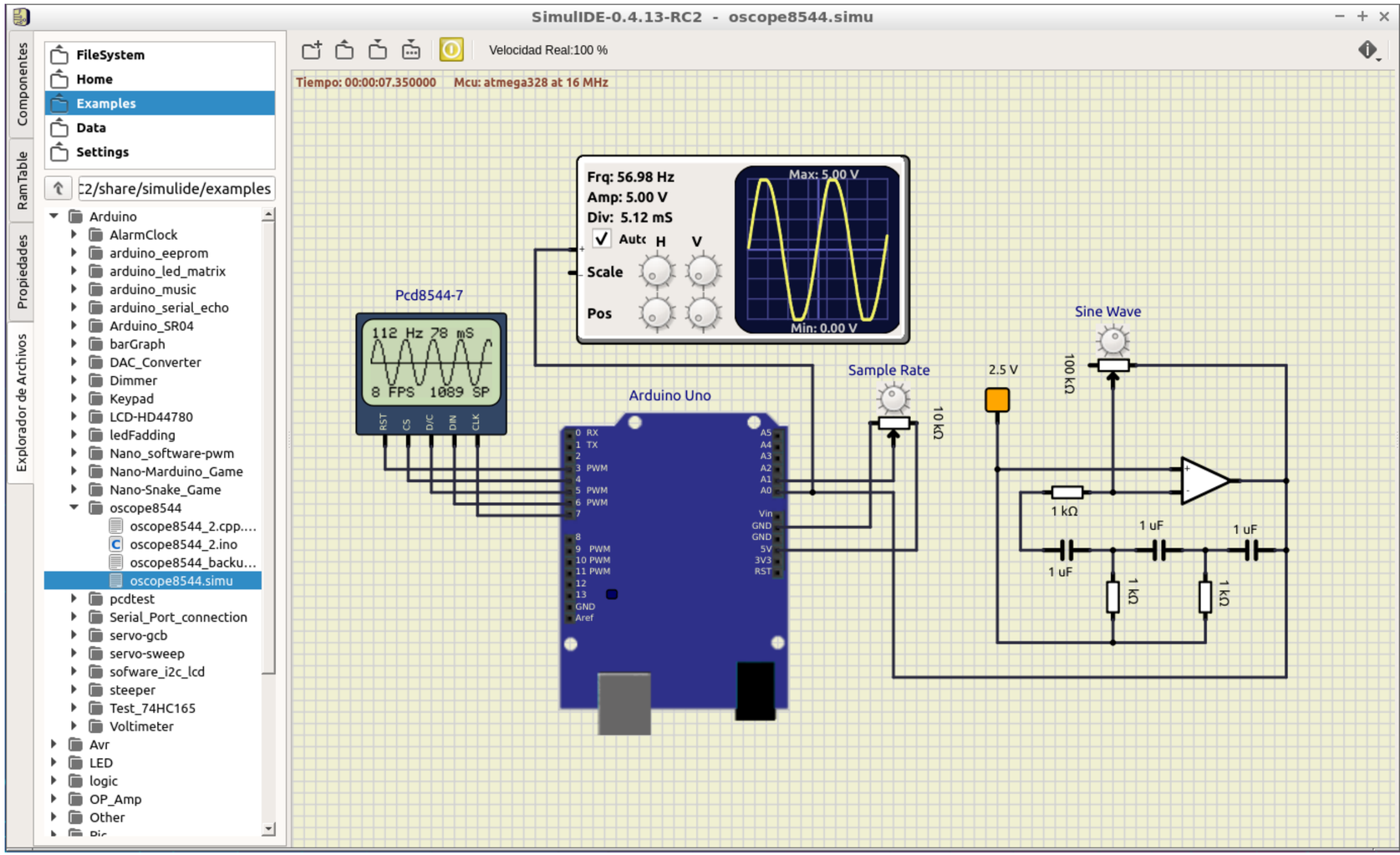
Embedded systems for IoT

Conclusions

# SIMULIDE Simulator



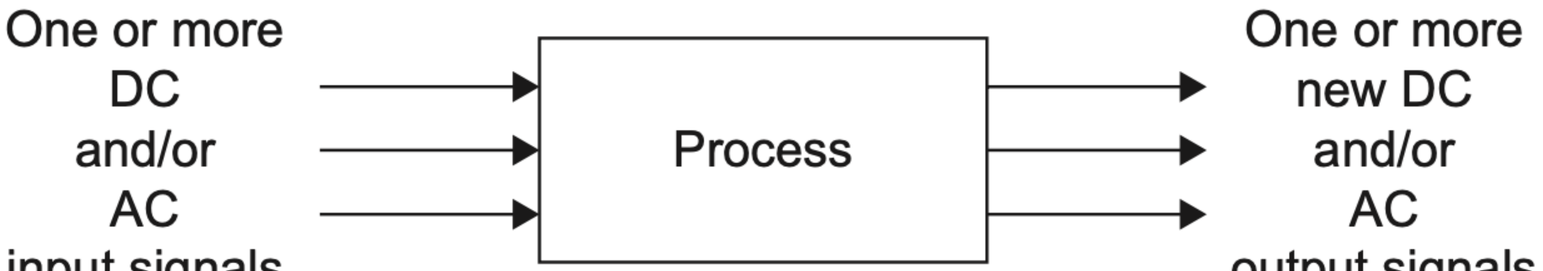
- **It is an open source approximated high-level simulator.**
  - The simulation results are not strictly accurated, still the results are valid.
  - **This is good:** because it is very fast for execution,
  - **Download and install from:**
  - https://www.simulide.com/p/downloads.html



# Introduction: the painful truth

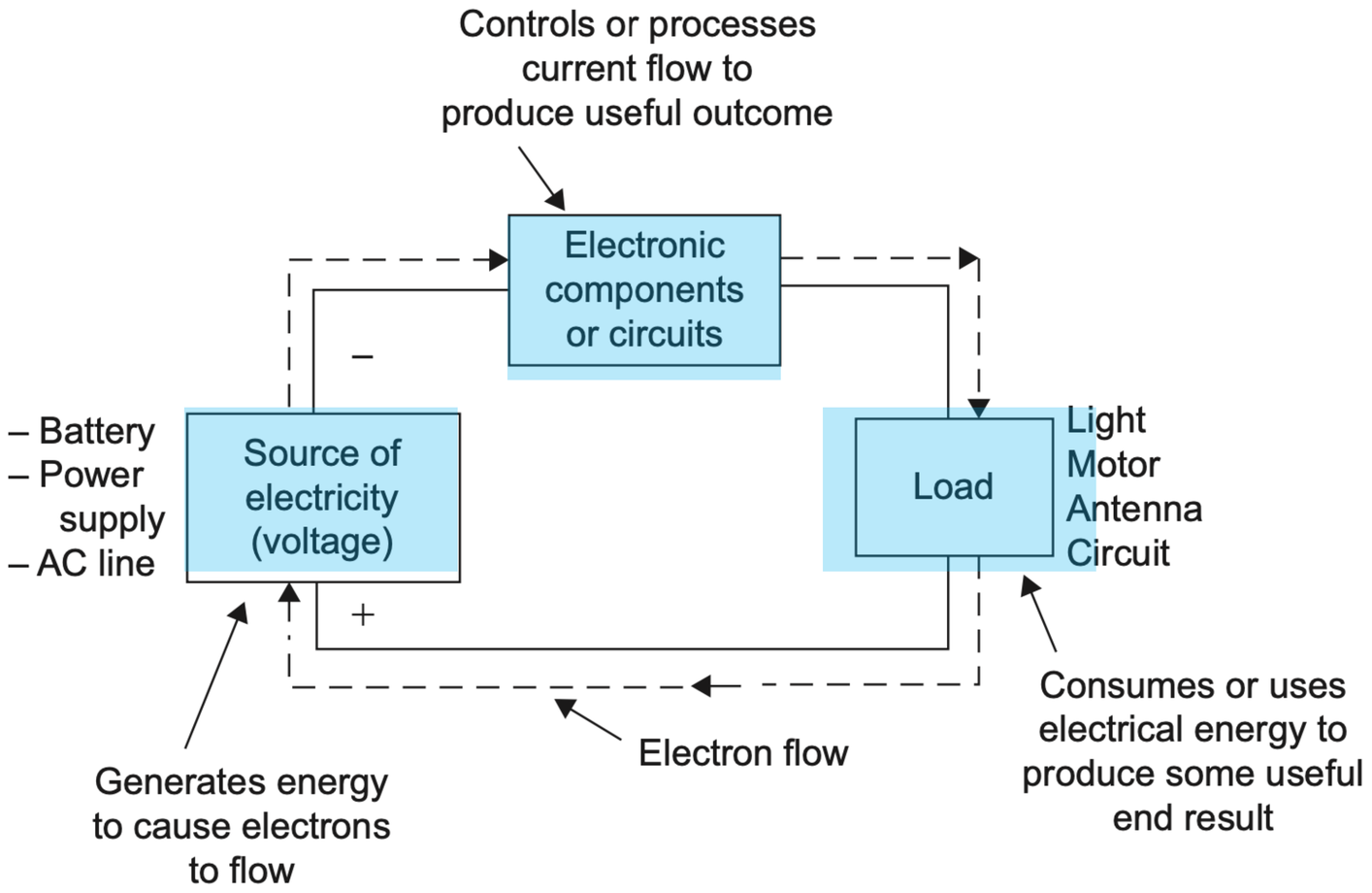


- **How it works?:** at least all electronics ☺




- Amplify
- Attenuate
- Modulate
- Translate
- Math
- Logic
- Interpret
- Decision making

# Basic electrical circuit model

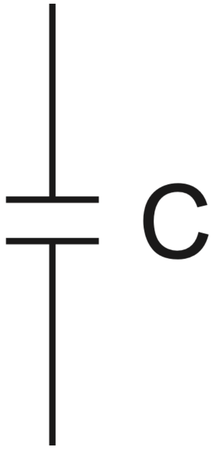


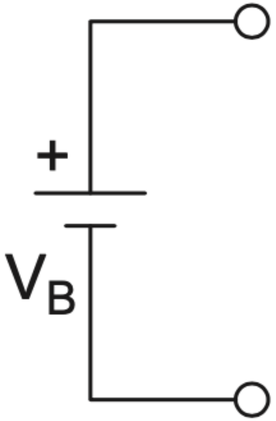

- **Answer:** list electronic components.
- **Also:** How do they work?

# Circuit elements

- How do they work? Passive vs active elements?



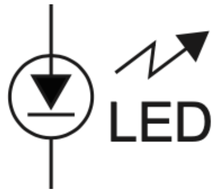



| Resistor | Inductor | Capacitor |
|---|---|---|

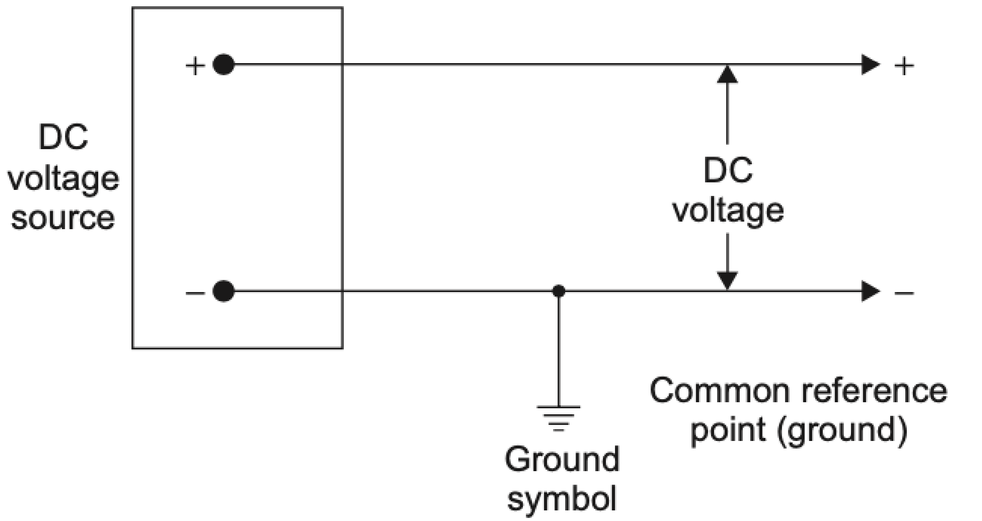
**Voltage Source**

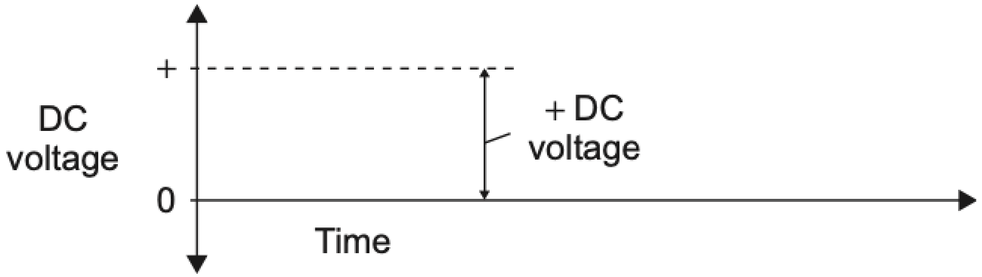
- What about a LED?



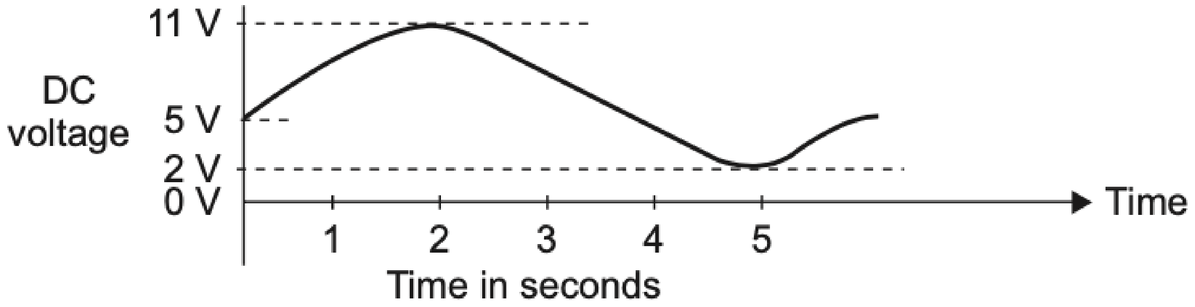
# DC Voltage



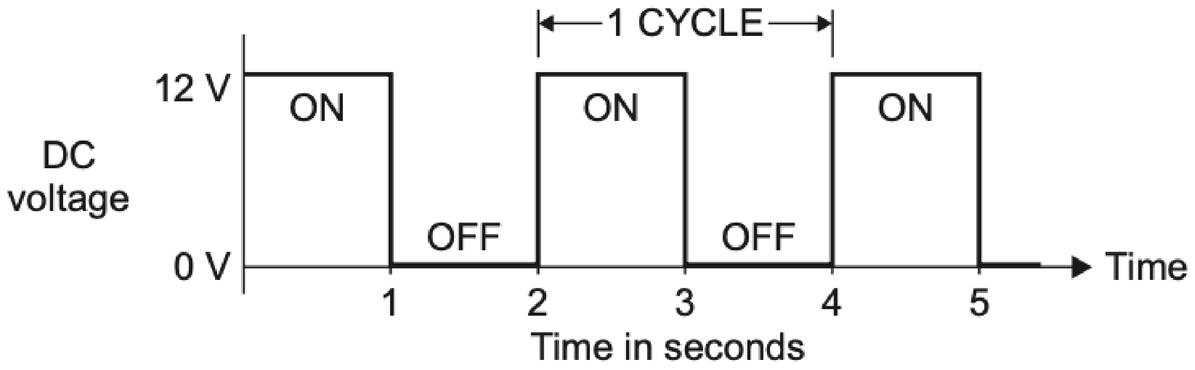



*Fixed, positive DC voltage*




*Varying, positive DC voltage*




*Pulsating DC voltage*

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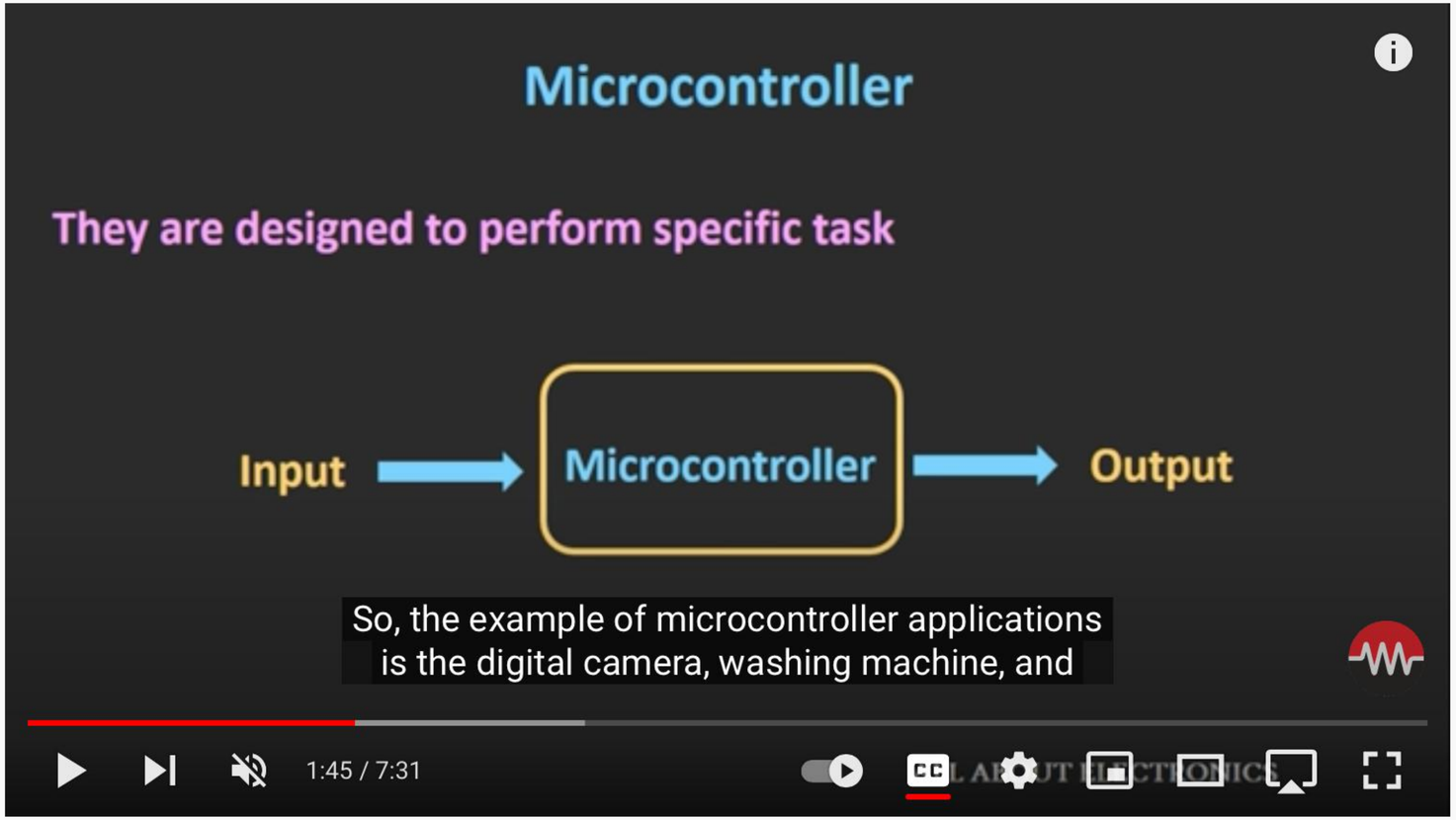
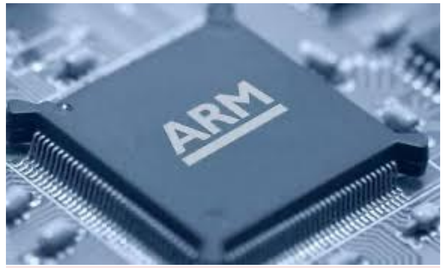
# Microprocessor vs microcontroller

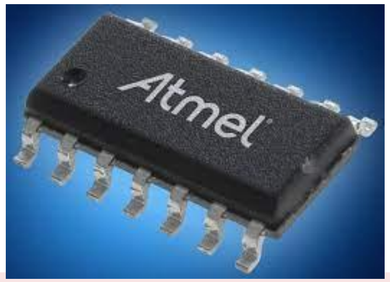
- https://www.youtube.com/watch?v=dcNk0urQsQM



# Types of devices






| | Microprocessors | Microcontroller |
|---|---|---|
| Characteristics | General purpose hardware | General purpose hardware |
| **Components** | CPU | CPU, RAM, GPIO |
| Languages | C/C++,Python, etc. | C to Assembly |
| Main Companies | Intel, ARM, AMD | ATMEL, Microchip, Cypress |

**The components on a single chip or board makes a big difference.**

**Also ISA (or instructions), microcontroller is limited**

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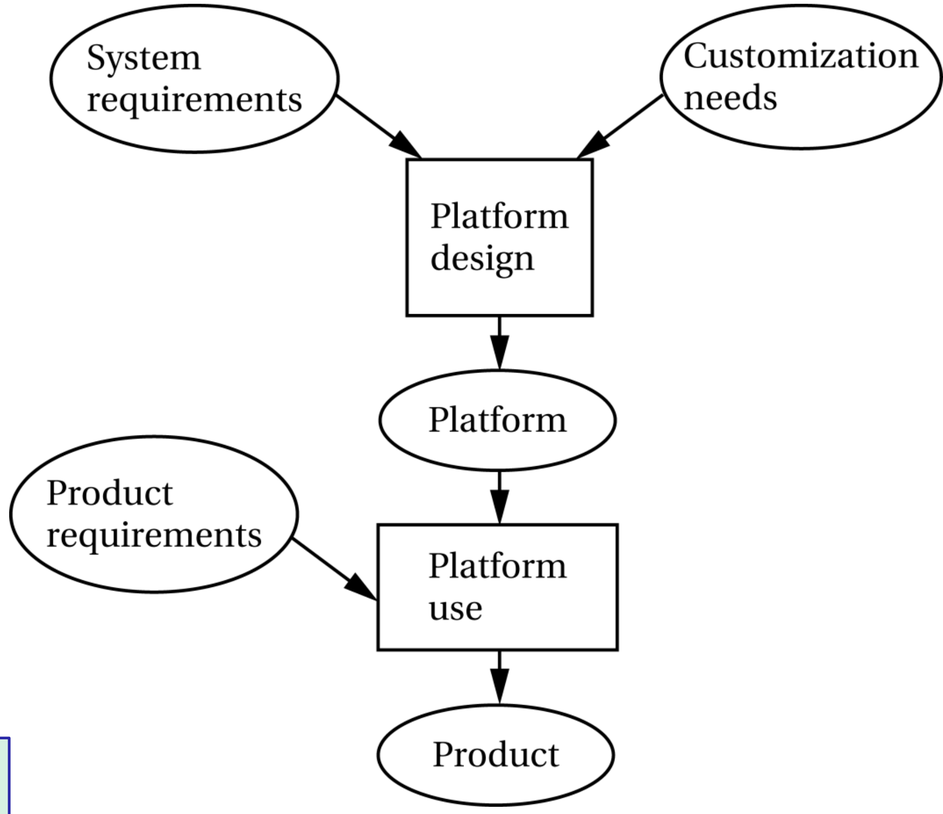
# Embedded systems for IoT

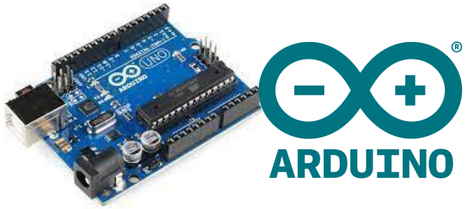
- **Platform-based (hardware) design**
  - Platform includes hardware, supporting software.
- Two stage process:
  1. Design the platform.
  2. Use the platform.
- Platform can be reused to host many different systems.

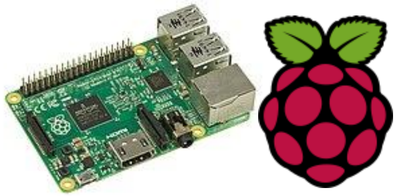



**Smart sensing** is the first requirement.

# Types of devices





| | Arduino | Raspberry |
|---|---|---|
| Characteristics | Microcontroller based board | Microcomputer (or microprocessor based board). |
| **Components** | CPU, RAM, GPIO | CPU, RAM, GPIO |
| Languages | C to Assembly. | C/C++,Python, etc. |
| Main Component | ATMEL microcontroller | SoC with ARM microprocessor |

**Because a microcomputer is larger in capabilities, it can execute minimal OS (e.g., tinyLinux).**

**We will cover more details during lab sessions ☺**

# Outline



Course Logistics

Introduction

IoT design perspective

Embedded systems for IoT

Conclusions

# Summary



- **We introduced circuit components that model the behaviour of sensors on an IoT system**
- **We review the IoT requeried hardware:**
  - Infraestructure and architectural