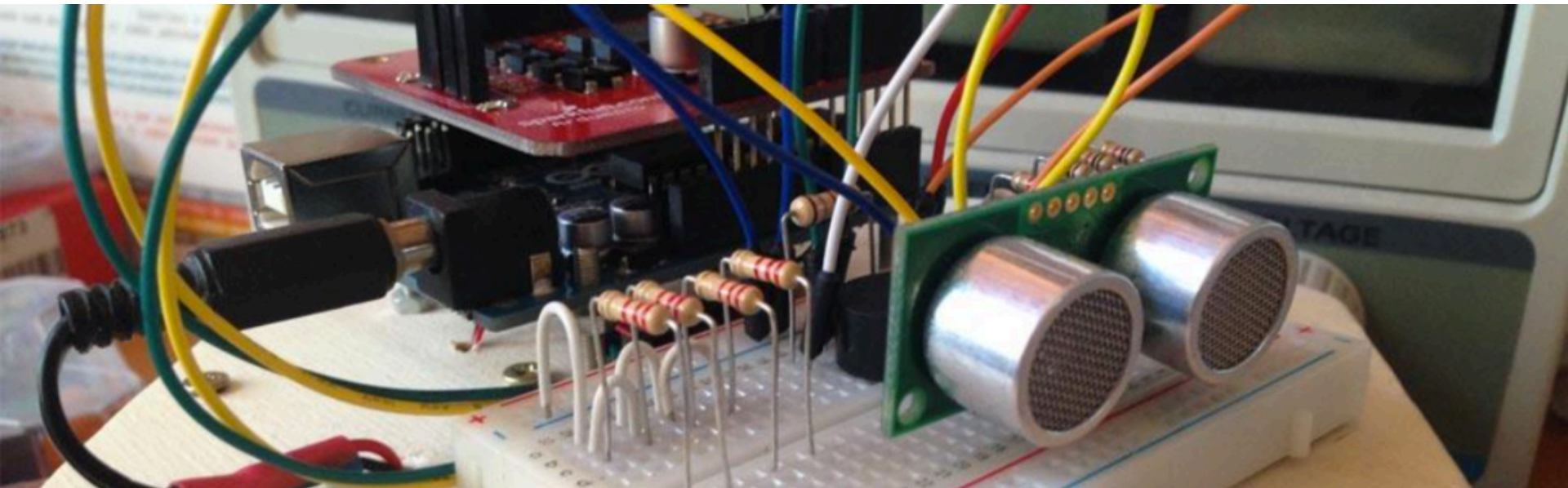


# Electronic Prototyping

## Analog to digital converter

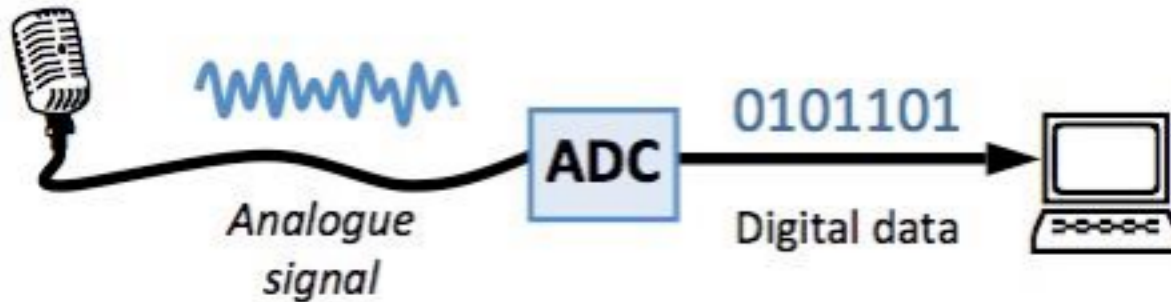
### Lesson 5

PhD Student Licia Di Pietro



# Analog to digital converter

---



# The Analog to Digital Conversion Process (1/2)

---

- Sounds are analog - they are made of waves that travel through matter. People hear sounds when these waves physically vibrate their eardrums.
- Since Computers are digital devices, they cannot understand these continuous pressure variable analog signals, so they communicate digitally, using electrical impulses that represent 0s and 1s ( i.e., through Binary).

## **Binary Notations:**

- One binary digit (0 or 1) is referred to as a bit, which is short for binary digit. One bit can only be used to represent 2 different values: 0 and 1.
-

# The Analog to Digital Conversion Process (2/2)

---

- To represent more than two values, we need to use multiple bits.
- Two bits combined can be used to represent 4 different values:
  - 00, 01, 10, and 11.
- Three bits can be used to represent 8 different values:
  - 000, 001, 010, 100, 011, 101, 110 & 111.
- In general, 'n' bits can be used to represent  $2^n$  different values.

$2^0$	1
$2^1$	2
$2^2$	4
$2^3$	8
$2^4$	16
$2^5$	32
$2^6$	64
$2^7$	128
$2^8$	256
$2^9$	512
$2^{10}$	1024
$2^{11}$	2048
$2^{12}$	4096

# Arduino Due ADC

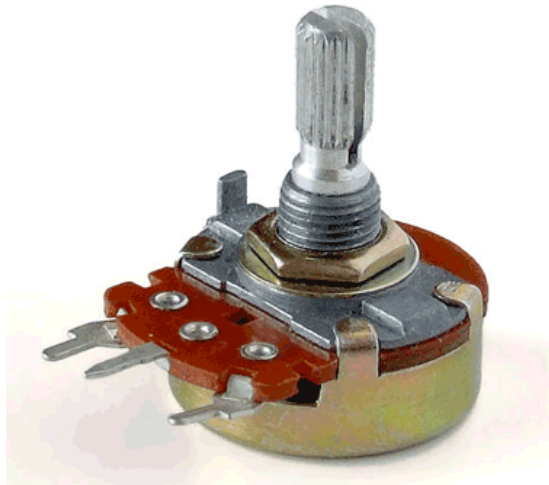
---

- The **Due** has the following hardware capabilities:
    - Resolution is defaults to 10 bits (returns values between 0-1023)
      - 2 pins with 12-bit DAC (Digital-to-Analog Converter)
    - The Due boards have 12-bit ADC capabilities that can be accessed by changing the resolution to 12.
      - This will return values from `analogRead()` between 0 and 4095.
-

# Example 1: Potentiometer

---

- Simulation of analog sensor using a potentiometer



**Open Example 1 in the share folder**

---

# Example 2: Millivolts value

---

- Simulation of analog sensor using a potentiometer and conversion in millivolts

**Open Example 2 in the share folder**

---

# Exercise: Temperature sensor LM35

---

- Find the Datasheet
- Reading the temperature and print the value in:
  - Celsius
  - Fahrenheit
  - Kelvin

