

# Physics and Astronomy Camp 2019

## Microcontroller with Python

UBC Physics & Astronomy

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## What is a microcontroller?

A *microcontroller* is a small computer. It contains one or more CPUs, memory, and input/output peripherals. Small in that they typically

- ▶ have slower processors
- ▶ have smaller memory and much smaller storage
- ▶ consumes less power

## What can a microcontroller do?

Microcontrollers are everywhere. Anything that runs on electricity and has an interactive interface probably has a microcontroller in it.

- ▶ Microwaves, kettles, ovens, ...
- ▶ Home assistants, volume-adjustable headphones, ...
- ▶ Automatic doors, traffic lights, drones, ...
- ▶ and more!

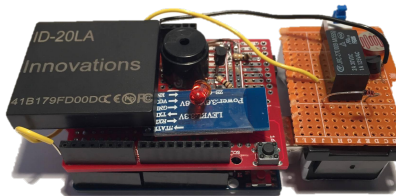
# Applications

## RFID item tracker



# Applications

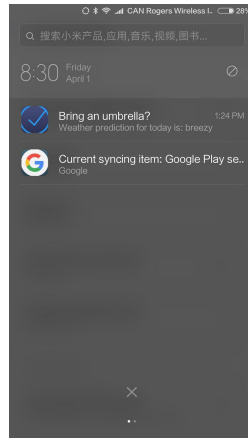
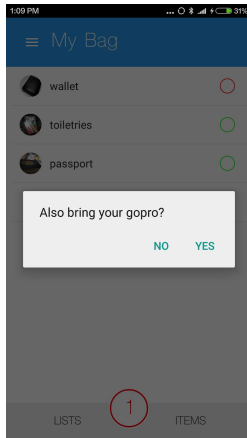
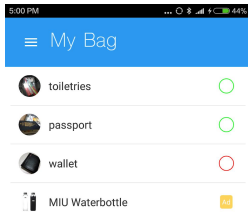
## RFID item tracker



**Figure:** Arduino with a RFID reader, buzzer, LED, and Bluetooth module powered by a 9V battery

# Applications

## RFID item tracker



## What is an Arduino?

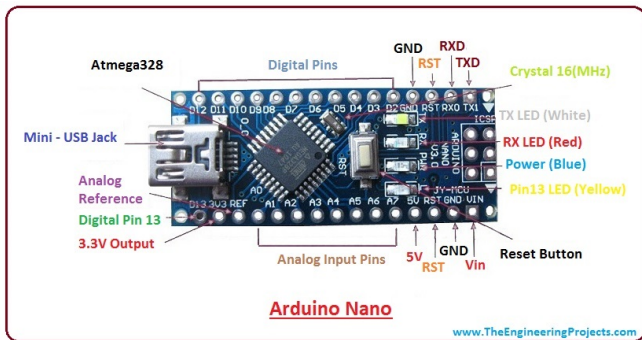


Figure: Arduino Nano Board

# Microcontroller Hardware



## What is an Arduino?

	Microcontroller	Computer
Processor	16 MHz	2 GHz
Storage	3 KB	256 GB
Memory	32 KB	4 GB
Peripherals	22 Pins	<i>Too many</i>
Power	0.1 W	100 W



# Arduino Programming

What will we learn today?

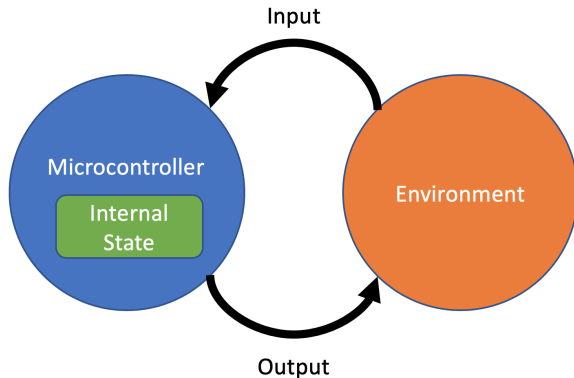


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We will learn two of the most important things — inputting and outputting signals. Different electronic components differ in the kinds of signals they accept.

# Arduino Programming

## Reactive Program



# Arduino Programming

## A typical microcontroller program

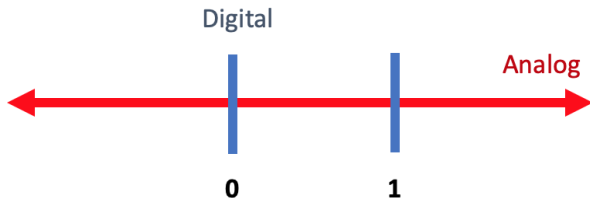


```
while True:
    # output 0V on D13
    board.digitalWrite(13, "LOW")
    time.sleep(1)

    # output 5V on D13
    board.digitalWrite(13, "HIGH")
    time.sleep(1)
```

# Aside: Digital and Analog

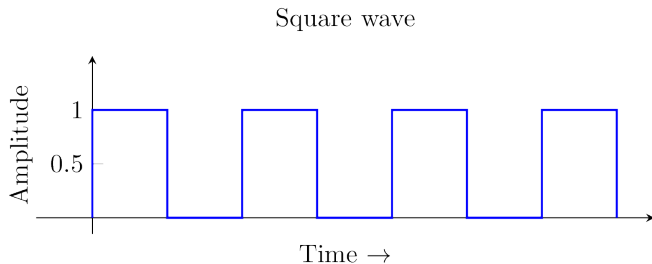
What is digital? What is analog?



In general general computers are almost always digital because working with 0s and 1s is easier and less error-prone.

# Aside: Digital Circuits

## Timing Diagram



# It's your turn!



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Material on the website.