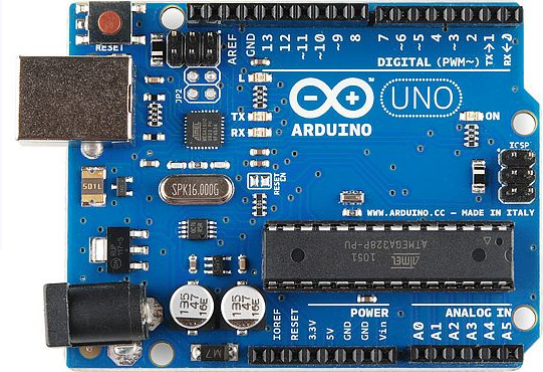# Programming the Arduino I

Let us revise!

- Microcontrollers
  - Arduino
- Basics of arduino programming
- Digital and Analog
- Sensors
 - Barometric Altimeter - BMP280
- Telemetry
  - XBee

Revise!

Microcontrollers

- Smart devices which can perform various tasks as instructed to it.
- We write set of codes called program which contains those instructions.
- Different from microprocessor which can only process data.
- Microcontrollers have on-board storage and peripherals to store and transfer data.
    - Microprocessor doesn't have that!
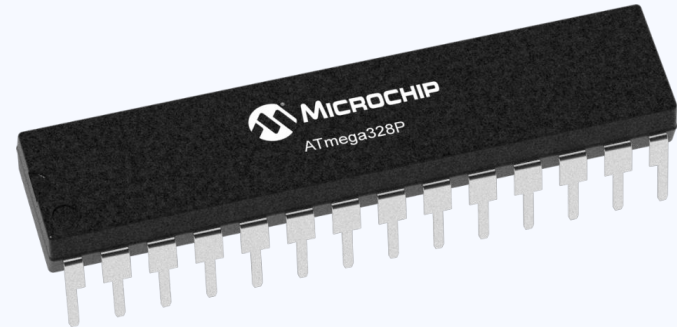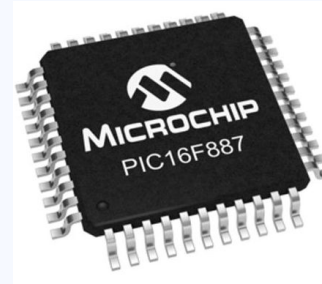
Arduino

- Arduino is an open source electronics platform.
- Provides both hardware and software.
  - Hardware: Arduino boards
  - Software: Arduino IDE
- Very easy to use microcontrollers with Arduino.
- Arduino nano
  - ATmega328P microcontroller
- Arduino uno is same as nano but bigger in size.
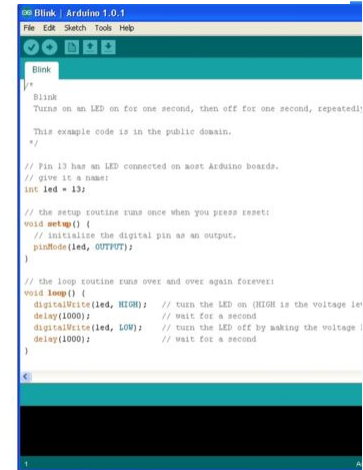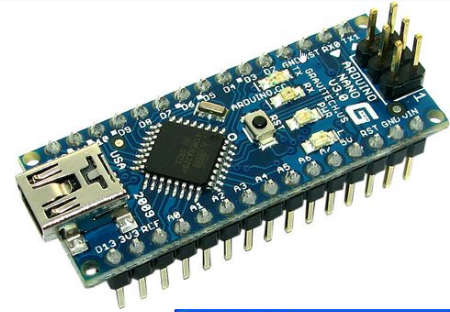
Basics of Arduino programming

- Variables and data types
  - For example: int num1 = 33;
    float num2 = 2.78;
- Conditional statements
  - if
  - else

Example:

if(a>b)

    ----Run statement 1---

else

    ----Run statement 2---

```
int a = 5;
float b = 4.75;
if(a>b)
{
  Serial.print("Apple");
}
else
{
  Serial.print("Orange");
}
```

Basics of Arduino programming

- Conditional loop
  - for
  - while
- Functions
  - Block of code that will only run when we call it.
- Two important functions
  - void setup()
    - Runs the code inside only once
  - void loop()
    - Runs the code inside forever

```
void setup() {
  // put your setup code here, to run once:
  int n = 3;
  for(int i = 0; i<n; i++)
  {
    Serial.println("YES!");
  }
}
```

Basics of Arduino programming

- Conditional loop
  - for
  - while
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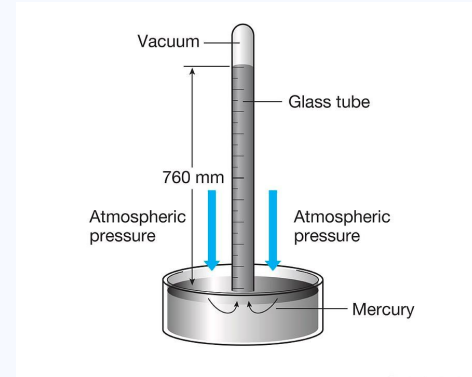
YES!

YES!

YES!

Digital and Analog

- Analog signals
  - Can take any value
- Digital signals
  - Can take only two values
  - We call those two values as "High" and "Low" value
- Arduino has digital and analog pins

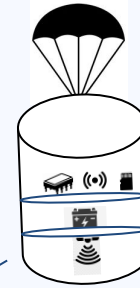| Signal #1	
Signal #2	
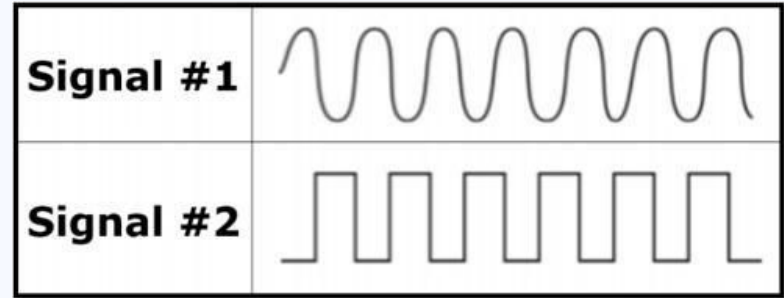
Sensors and barometric altimeter

- Sensors:
  - Devices that sense, measure
- Examples:
  - Heart rate, camera, temperature etc.
- Barometer:
  - Measures atmospheric pressure
- Altimeter:
  - Can calculate altitude using atmospheric pressure value
- BMP280
  - A sensor which can measure atmospheric pressure and temperature
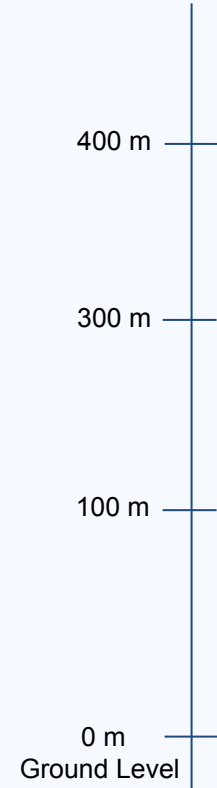 - Can I2C and SPI protocol

Telemetry

Satellite
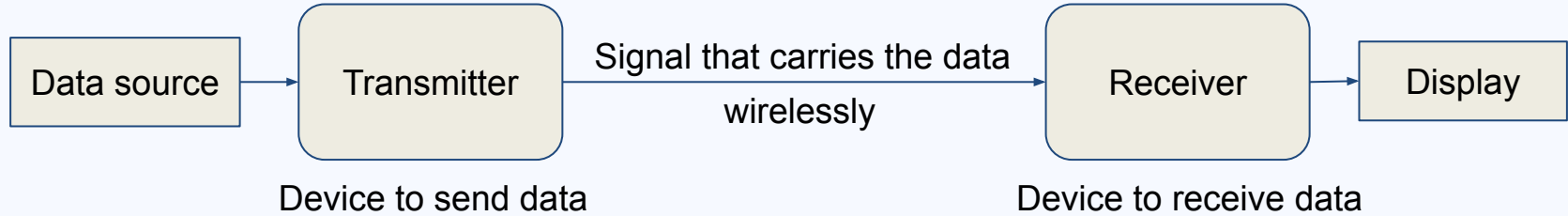
Weather Data

Ground Station

400 m

300 m

100 m

0 m
Ground Level

Components of Telemetry System

Data source → Transmitter → Signal that carries the data wirelessly → Receiver → Display

Device to send data

Device to receive data

Components of Telemetry System

Arduino + Sensors

| Data source | → | Transmitter | Radio waves | Receiver | → | Display |

Laptop

Device to send data   Device to receive data

- XBee
  - Can work as both transmitter and receiver
  - Uses UART protocol
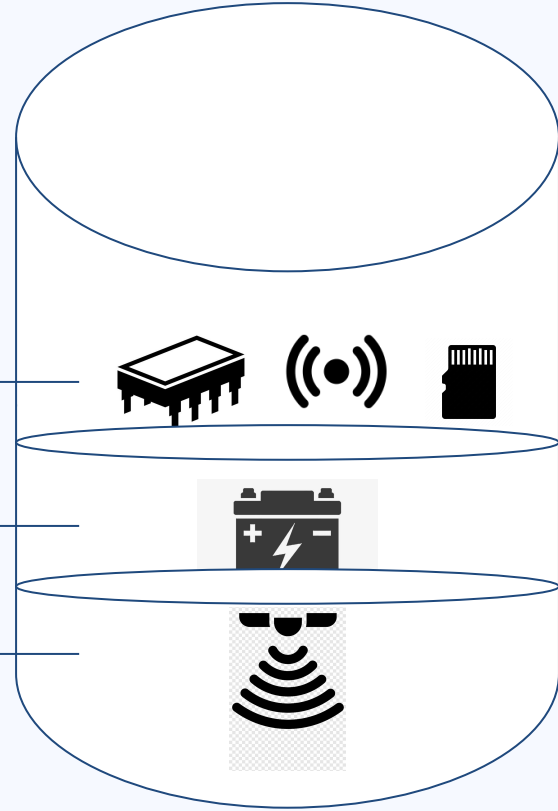
Basic Electronics in our Satellite

Mission
→ Sense/measure weather data
→ Process the data
→ Store it
→ Send it to ground station

Sensors and Processors

Power Source

Telemetry System

Arduino Program

- Get pressure, temperature and altitude data
- Write the data to SD card

Link to code

https://github.com/Team-Sammard/SATCAN-Material/blob/main/Programming%20the%20Arduino%20I/SATCAN_program/SATCAN_program.ino