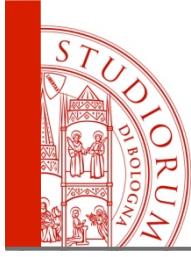
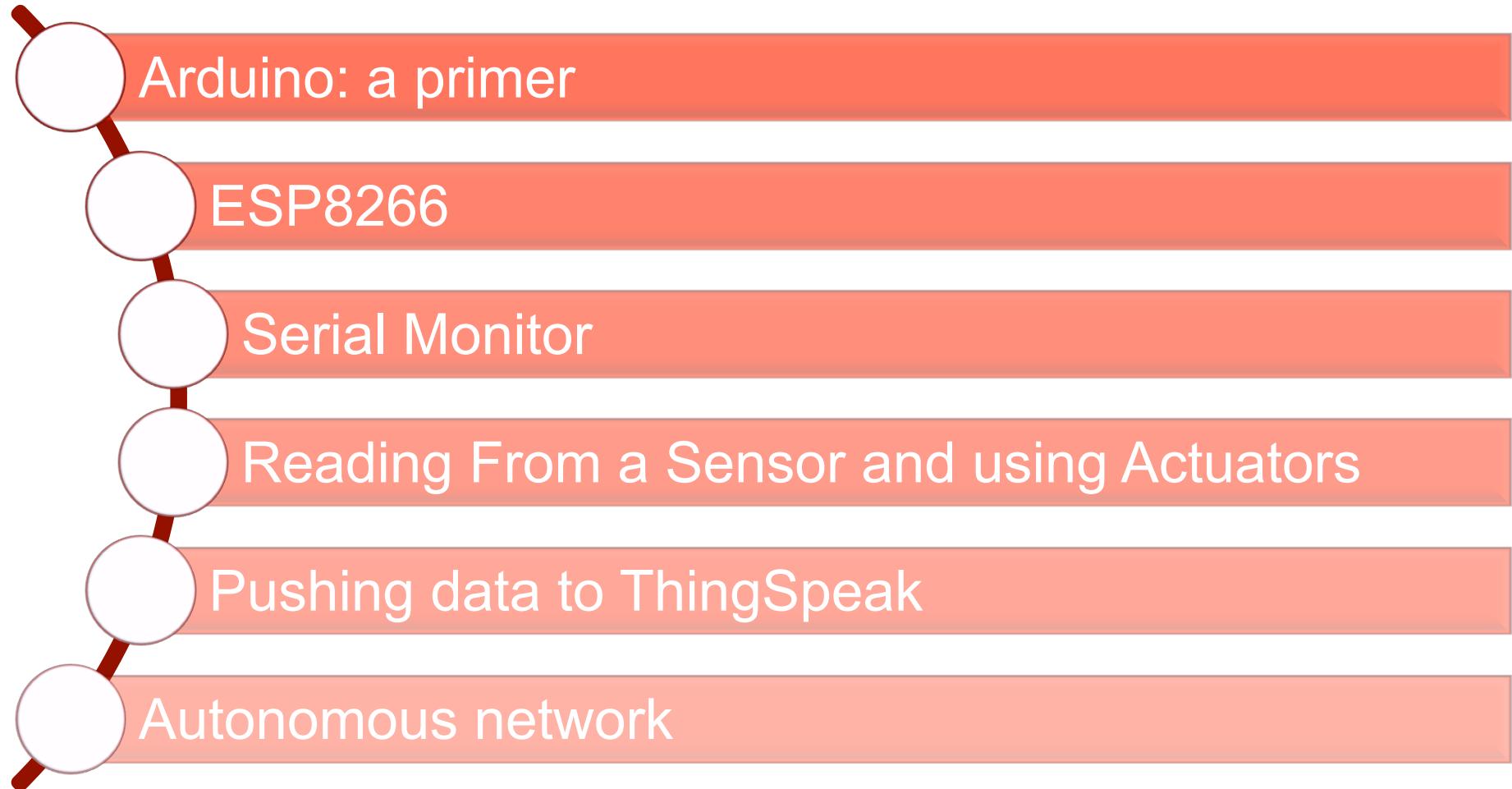


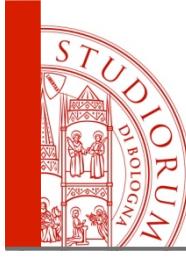
Arduino and ESP8266

*Luca Bedogni
luca.bedogni4@unibo.it
Sistemi Mobili 2016*



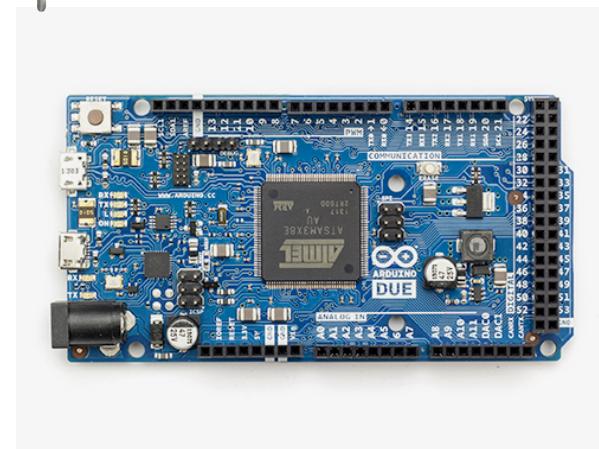
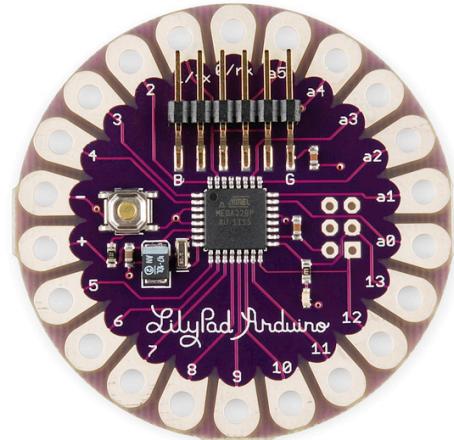
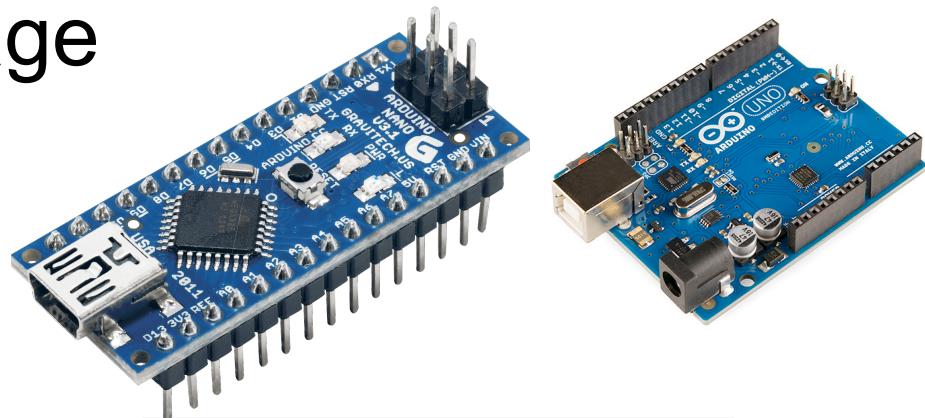
Outline

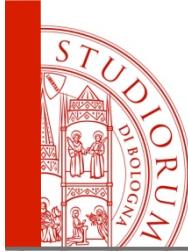




What is Arduino

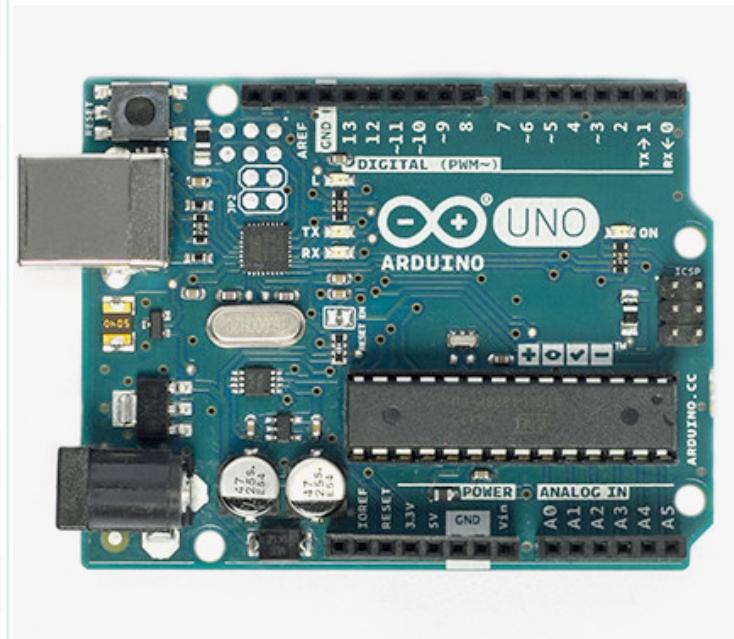
- Open source prototyping platform
- Own C-Like language
- Cheap
- Cross Platform

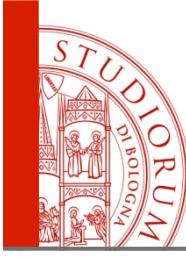




Arduino UNO

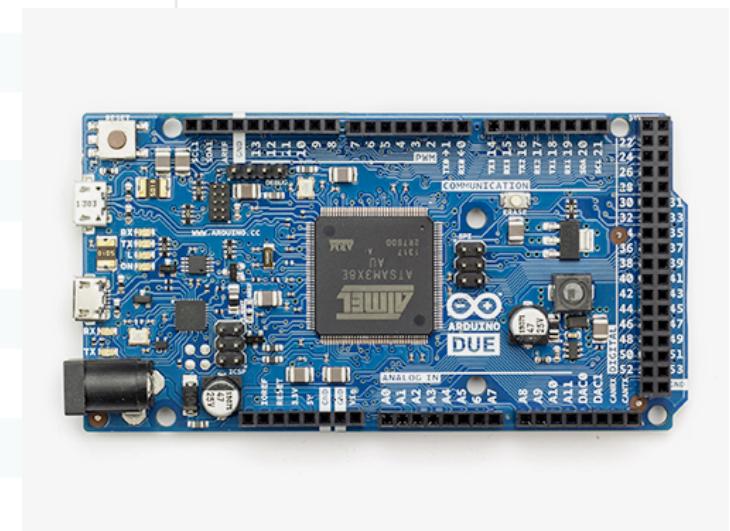
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

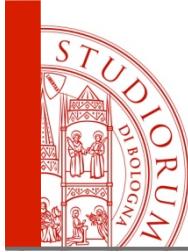




Arduino DUE

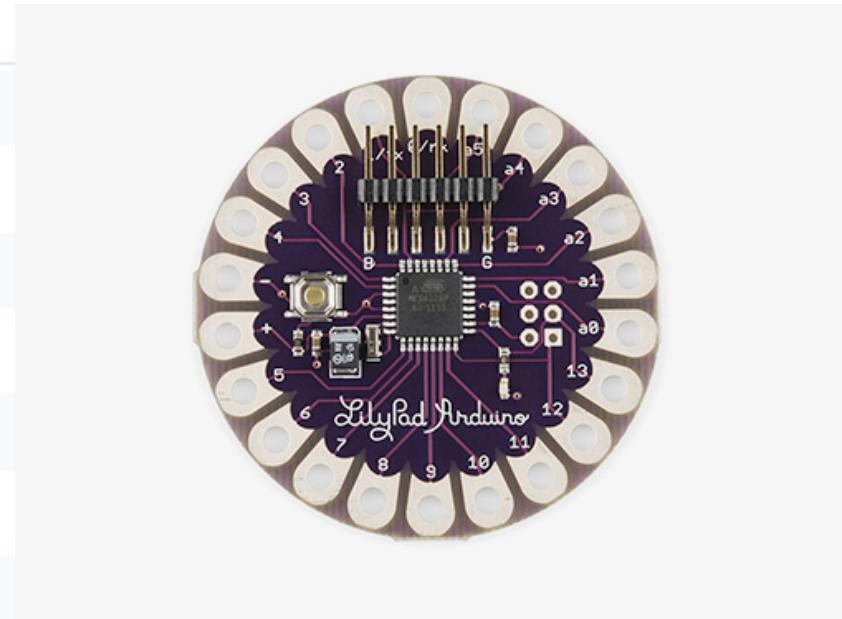
Microcontroller	AT91SAM3X8E
Operating Voltage	3.3V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-16V
Digital I/O Pins	54 (of which 12 provide PWM output)
Analog Input Pins	12
Analog Output Pins	2 (DAC)
Total DC Output Current on all I/O lines	130 mA
DC Current for 3.3V Pin	800 mA
DC Current for 5V Pin	800 mA
Flash Memory	512 KB all available for the user applications
SRAM	96 KB (two banks: 64KB and 32KB)
Clock Speed	84 MHz
Length	101.52 mm
Width	53.3 mm
Weight	36 g

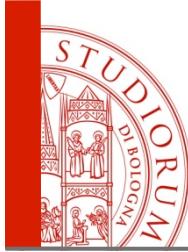




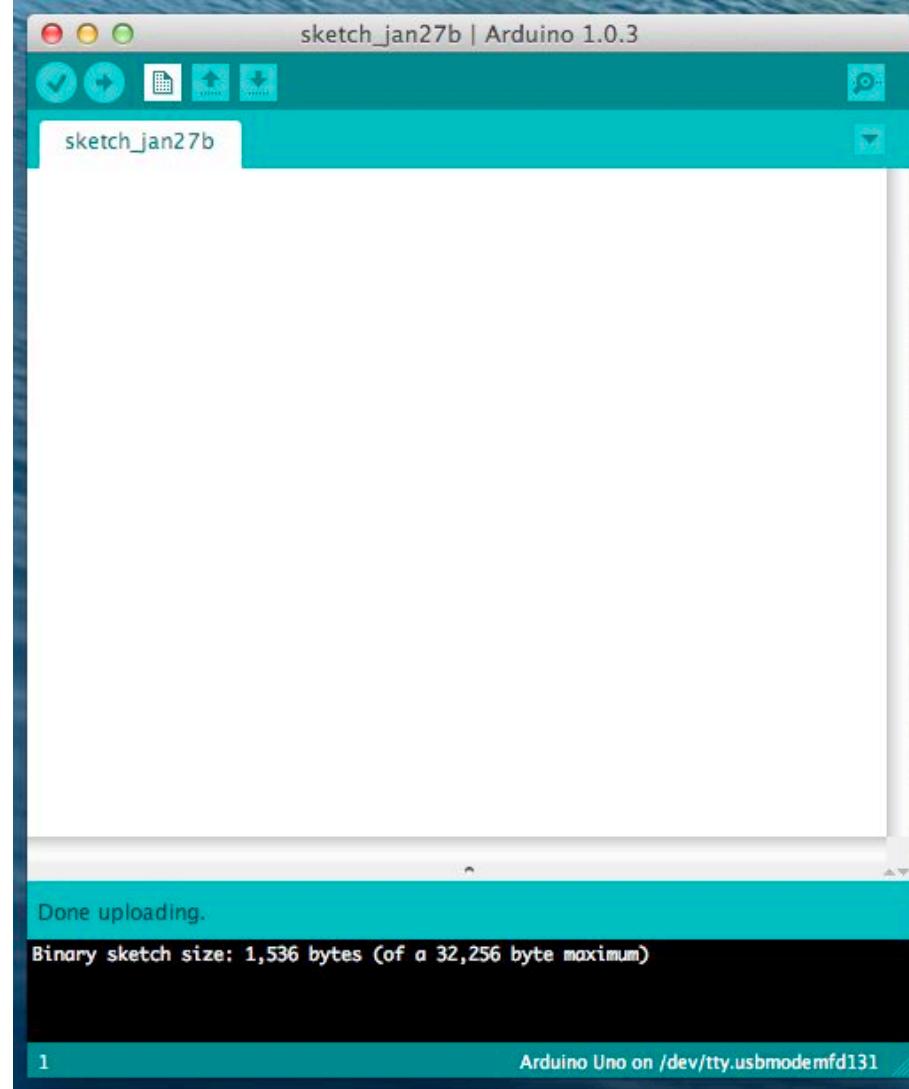
Lilypad

Microcontroller	ATmega168 or ATmega328V
Operating Voltage	2.7-5.5 V
Input Voltage	2.7-5.5 V
Digital I/O Pins	14
PWM Channels	6
Analog Input Channels	6
DC Current per I/O Pin	40 mA
Flash Memory	16 KB (of which 2 KB used by bootloader)
SRAM	1 KB
EEPROM	512 bytes
Clock Speed	8 MHz





How to program it?



C-like syntax

Two methods:

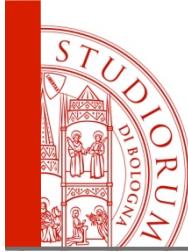
- void setup()
- void loop()

One editor for all platforms

Library extensible

Single compile-upload button

Integrated Serial monitor



Community

ARDUINO | OUTSIDE USA

USA ONLY

Home Buy Download Products ▾ Learning ▾ Forum Support ▾ Blog LOG IN SIGN UP

Arduino Forum

Using Arduino

Installation & Troubleshooting
For problems with Arduino itself, NOT your project
Last post: Today at 03:19 pm MOVED: Arduino robot pro... by AWOL

64,453 Posts 15,262 Topics

Project Guidance
Advice on general approaches or feasibility
Last post: Today at 03:26 pm Connecting Arduino or AT... by sethmoening

312,331 Posts 43,263 Topics

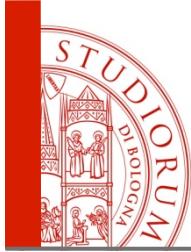
Programming Questions
Understanding the language, error messages, etc.
Last post: Today at 03:21 pm Re: Easy driver and spar... by TomGeorge

435,585 Posts 52,987 Topics



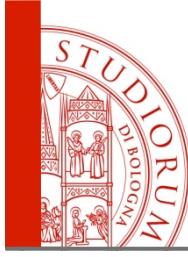
ESP8266

- System on Chip (SoC)
- Low cost
- Full TCP/IP stack (!!!)
- Can be flashed with different firmwares
- Can also be programmed with Arduino IDE
- Many models



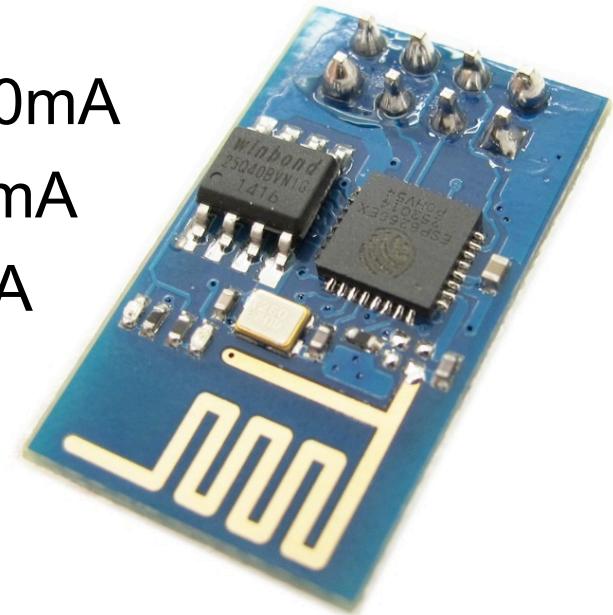
... but how many?

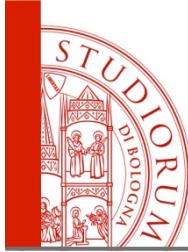




ESP8266-01

- 802.11 b/g/n
- Input power: 3.3V
- I/O voltage tolerance: 3.6V Max
- Regular operation current draw: ~70mA
- Peak operating current draw: ~300mA
- Power down leakage current: <10 μ A
- +19.5dBm output in 802.11b mode
- Flash Memory Size: 1MB (8Mbit)
- WiFi security modes: WPA, WPA2
- Module's dimensions: 24.75mm x 14.5mm

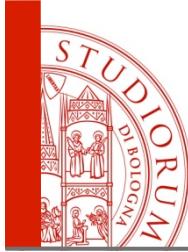




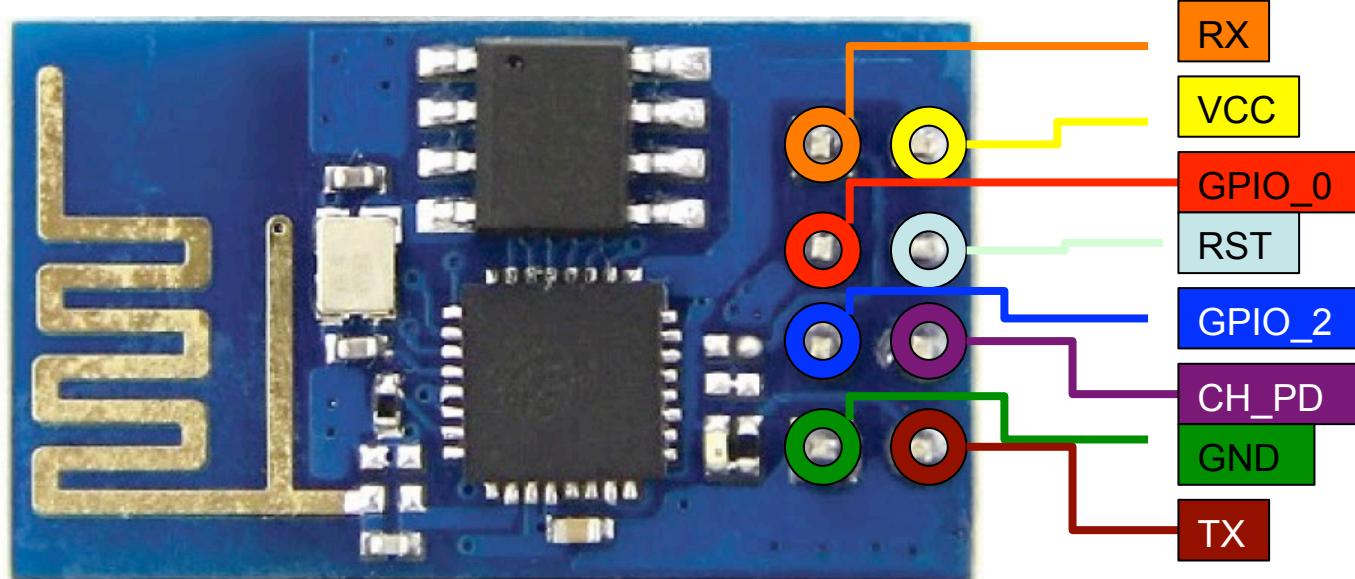
ESP8266-12

- 802.11 b/g/n
- Input power: 3.3V
- Integrated 10-bit ADC
- Deep sleep power <10uA
- Power down leakage current < 5uA
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)
- +20 dBm output power in 802.11b mode



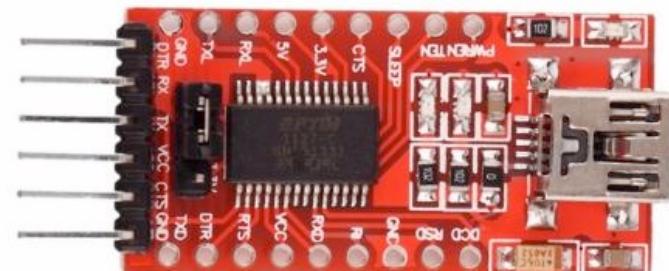


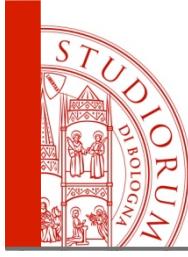
Wiring (ESP8266-01)



ESP8266-01 USB-SERIAL

RX	TX
TX	RX
CH_PD	3.3 V
VCC	3.3 V
GND	GND
GPIO_0	GND (when flashing)





A first example

- Serial interface to arduino
- void setup() is executed once
- void loop() is executed repeatedly
- Serial.println() prints a messages
- delay() sleeps for the given amount of time



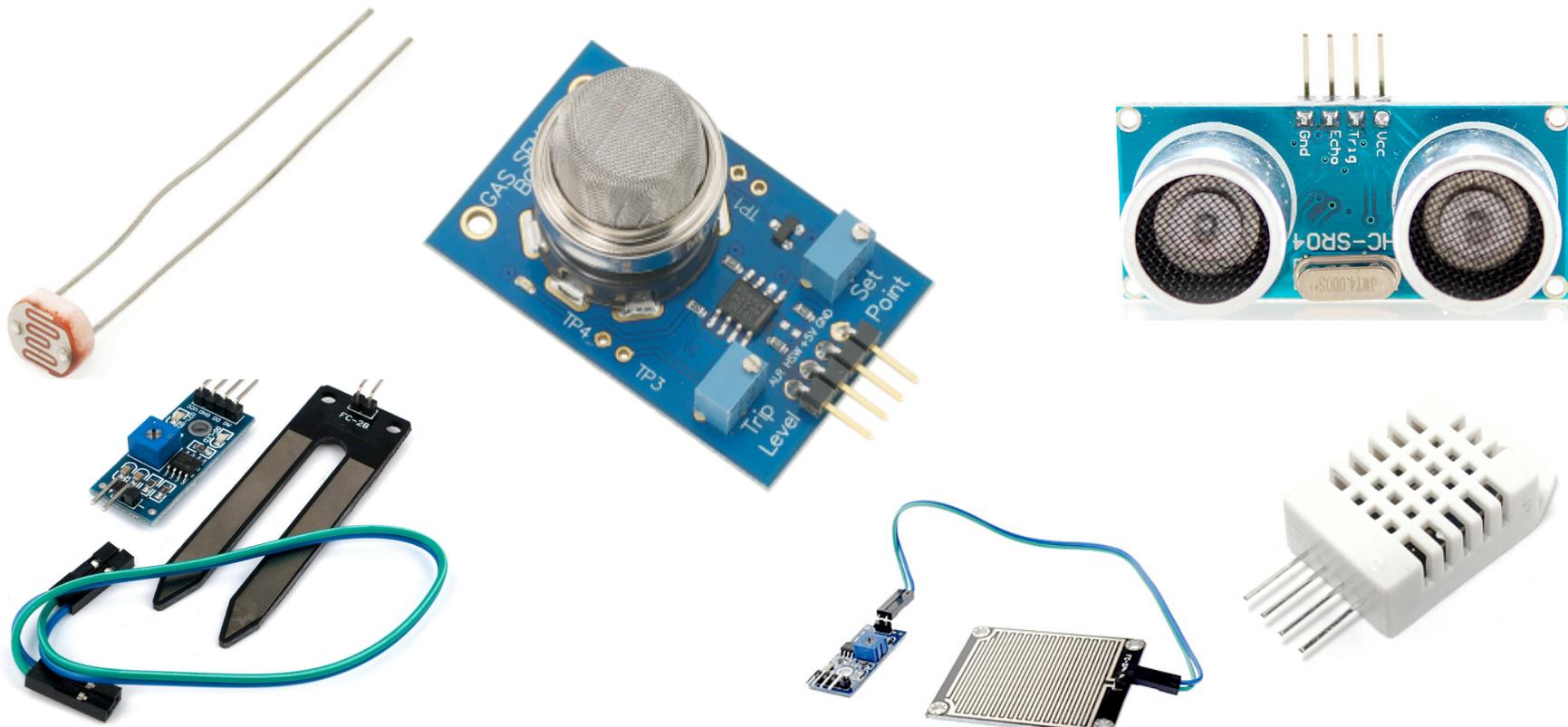
Code

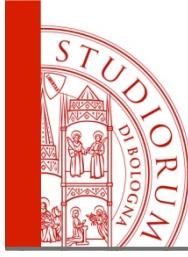
```
1 int counter = 0;
2
3 void setup() {
4     Serial.begin(9600);
5     Serial.println("**** ROUND BEGIN ***");
6 }
7
8 void loop() {
9     Serial.println(counter);
10    delay(1000 - (counter * 100));
11    counter = counter + 1;
12
13 if (counter > 10) {
14     counter = 0;
15     Serial.println("**** ROUND BEGIN ***");
16 }
17 }
18 }
```



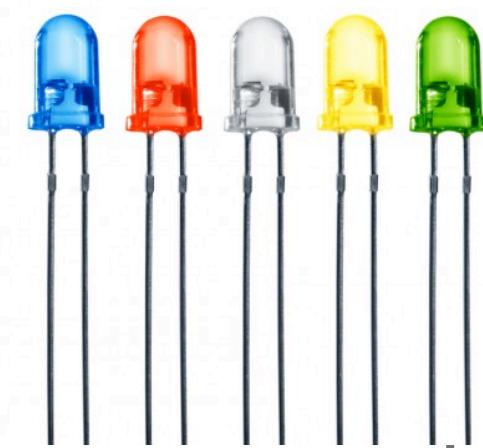
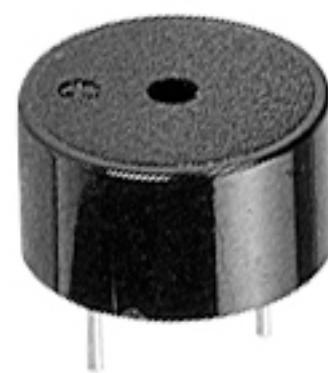
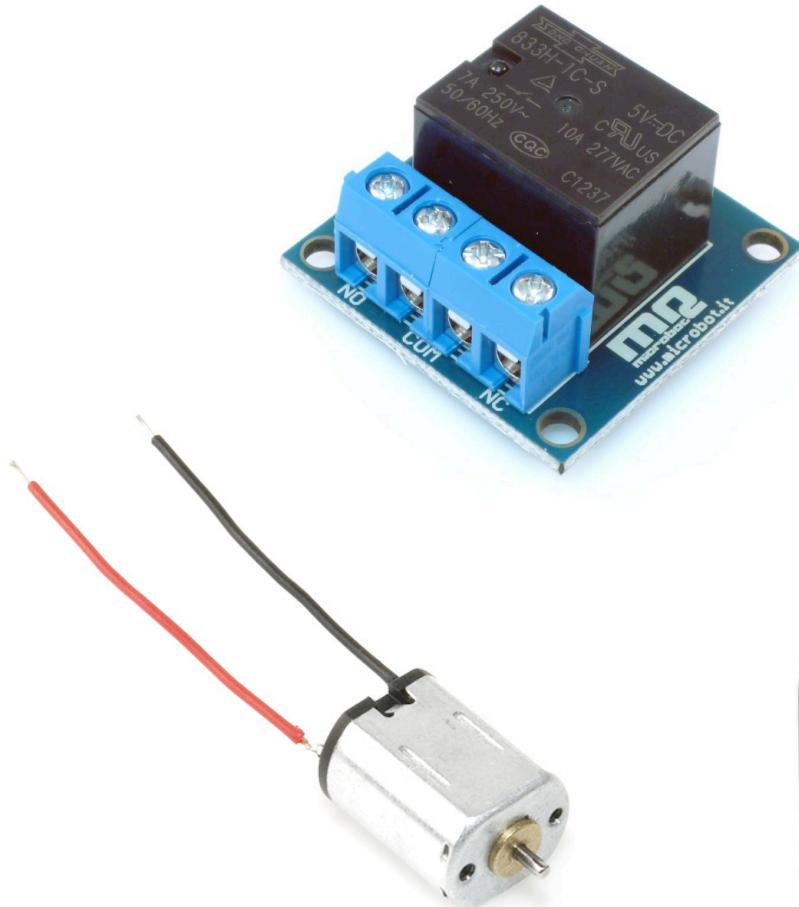
Sensors

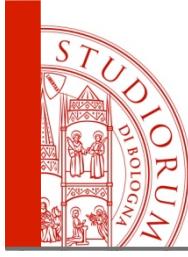
- Each sensor has its own methods



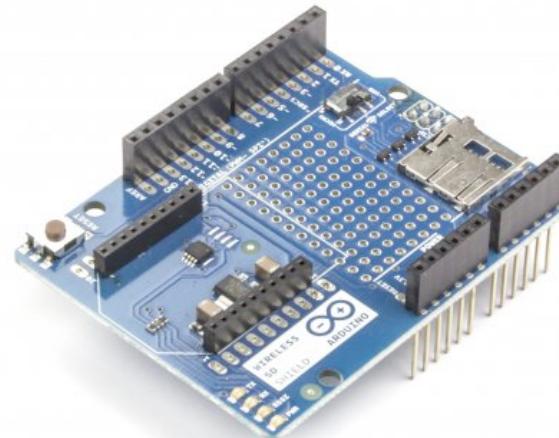
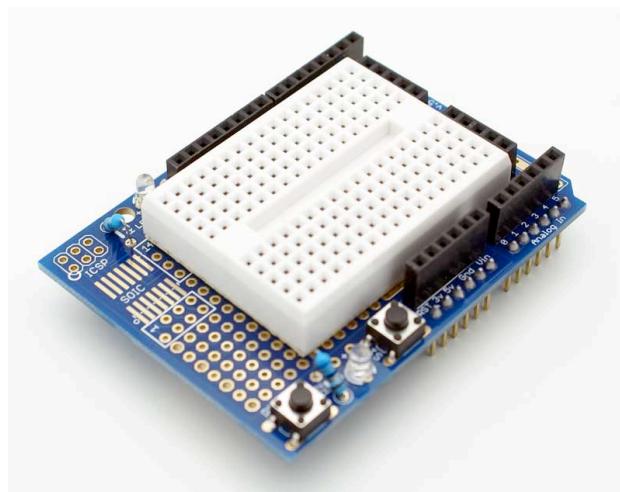
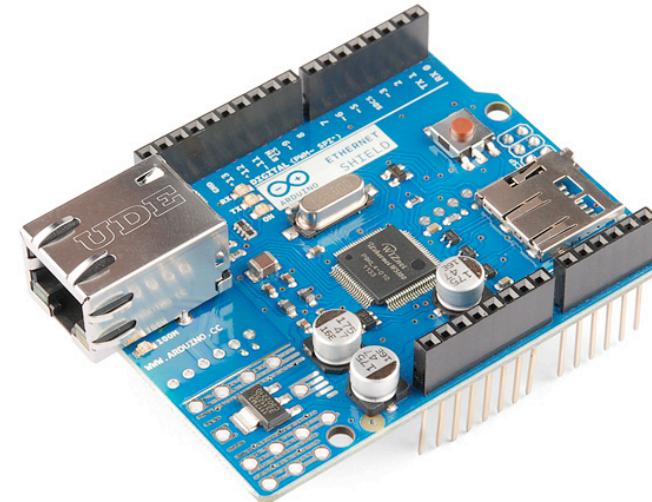
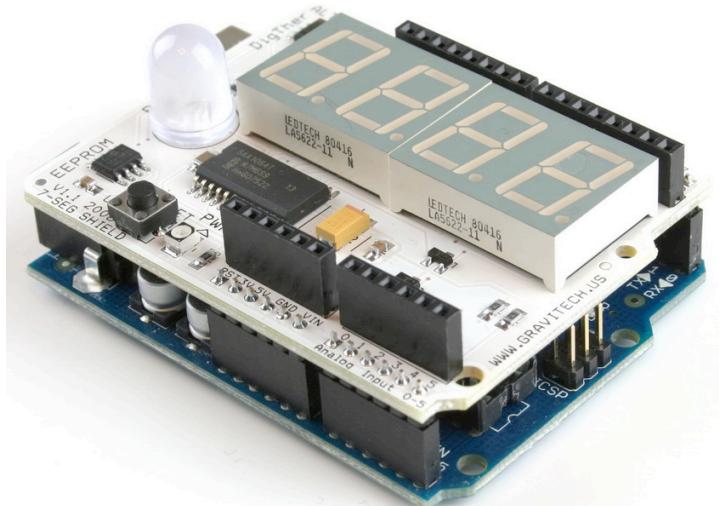


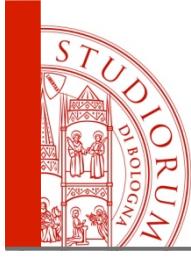
Actuators



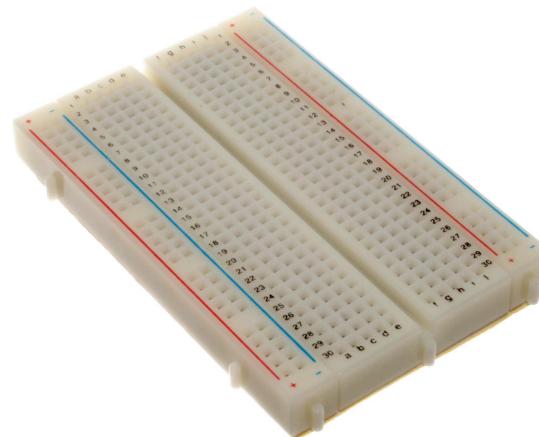
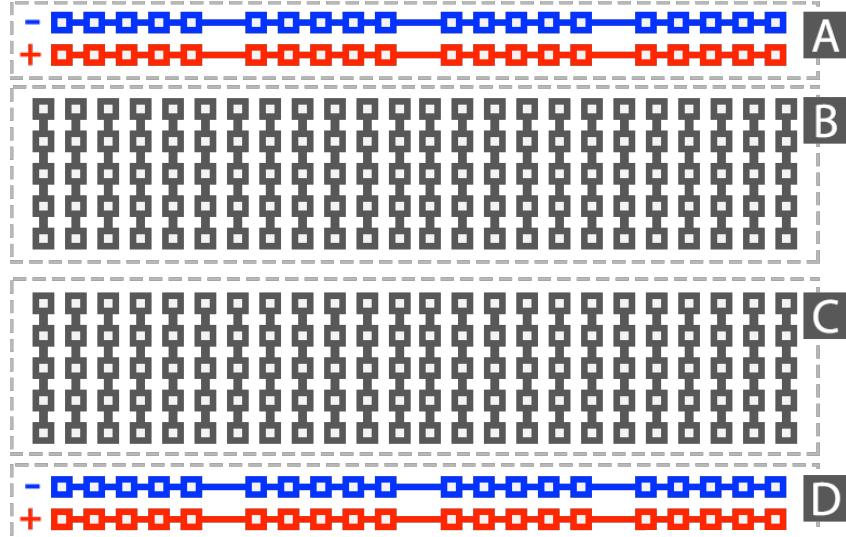


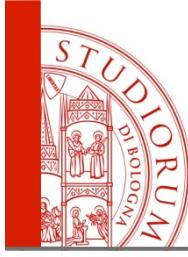
Shields





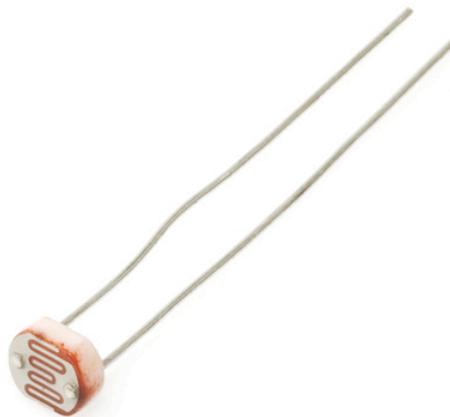
Breadboards





A second example

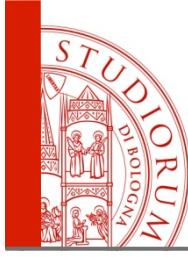
- We read from a sensor (light)
- We print the value
- We dim the led light according to the sensed light





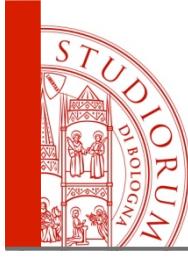
Code

```
1 #define LED_PIN 3
2 #define LIGHT_PIN A0
3
4 int value;
5 void setup() {
6     Serial.begin(9600);
7     Serial.println("Example number 2");
8 }
9
10 void loop() {
11     value = analogRead(LIGHT_PIN);
12     int l = map(value, 100, 700, 255, 0);
13     analogWrite(LED_PIN, l);
14     delay(20);
15 }
```



What is ThingSpeak

- Platform for IoT applications
- Real-time data collection
- Visualize data in charts
- Private and Public channels
- Register and create your first channel



ThingSpeak channels

[ThingSpeak](#) [Channels](#) [Apps](#) [Blog](#) [Support](#) [Account](#) [Sign Out](#)

New Channel

Name

Description

Field 1

Field 2

Field 3

Field 4

Field 5

Field 6

Field 7

Field 8

Metadata

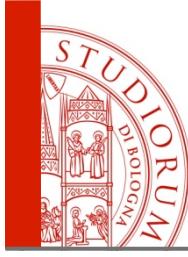
Help

ThingSpeak Channel

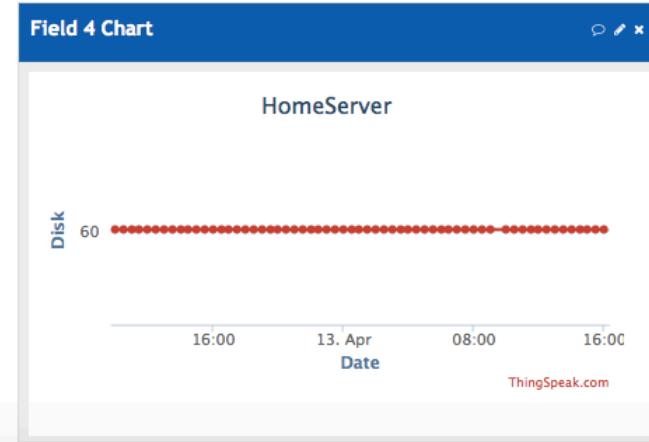
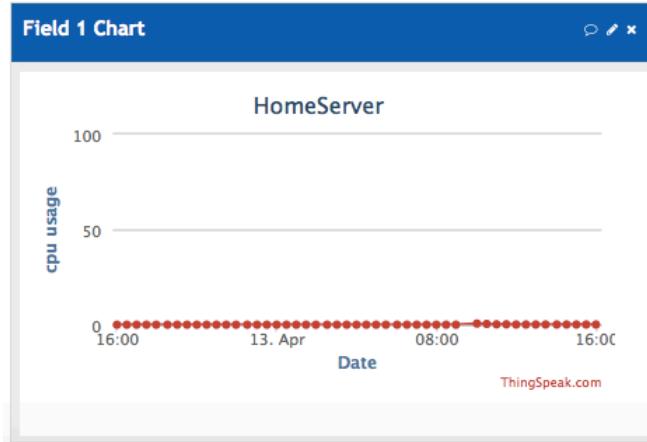
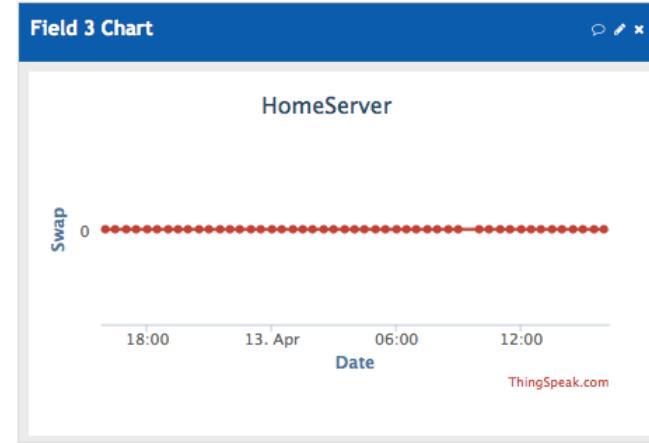
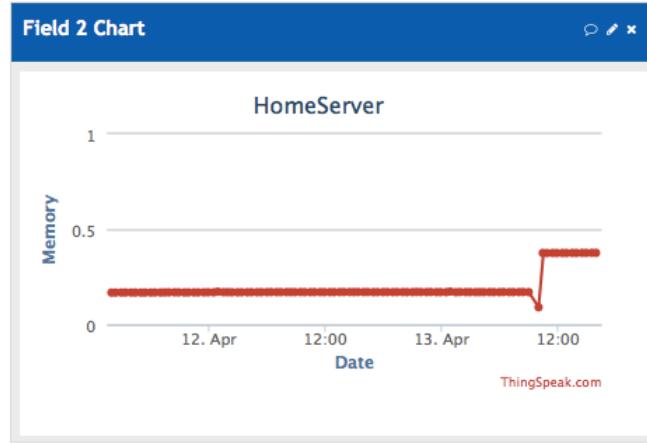
Channels store all the data that a ThingSpeak application collects. Each channel includes eight fields that can hold any type of data, plus three fields for location data and one for status data. Once you collect data in a channel, you can use ThingSpeak apps to analyze and visualize it.

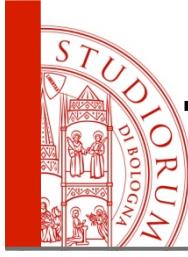
Channel Settings

- **Channel Name:** Enter a unique name for the ThingSpeak channel.
- **Description:** Enter a description of the ThingSpeak channel.
- **Field#:** Check the box to enable the field, and enter a field name. Each ThingSpeak channel can have up to 8 fields.
- **Metadata:** Enter information about channel data, including JSON, XML, or CSV data.
- **Tags:** Enter keywords that identify the channel. Separate tags with commas.
- **Latitude:** Specify the position of the sensor or thing that collects data in decimal degrees. For example, the latitude of the city of London is 51.5072.
- **Longitude:** Specify the position of the sensor or thing that collects data in decimal degrees. For example, the longitude of the city of London is -0.1275.
- **Elevation:** Specify the position of the sensor or thing that collects data in meters. For example, the elevation of the city of London is 35.052.
- **Make Public:** If you want to make the channel publicly available, check this box.
- **URL:** If you have a website that contains information about your ThingSpeak channel, specify the URL.



ThingSpeak channels





Temperature+Humidity device

- We use the DHT22 sensor
- 1-wire BUS
- We push humidity, temperature and heat index to ThingSpeak every 10 seconds
- With an ESP8266-01





Let's create the channel

New Channel

Name

Description

Field 1

Field 2

Field 3

Write API Key

Key



Code

```
1 #include "DHT.h"
2 #include <WiFiClient.h>
3 #include <ESP8266WiFi.h>
4 #include "SmartphoneWifi.h"
5
6 const char* ssid      = WIFI_SSID;
7 const char* password = WIFI_PWD;
8
9 #define DHTPIN 0
10 #define DHTTYPE DHT22
11 DHT dht(DHTPIN, DHTTYPE);
12
13 void setup() {
14     Serial.begin(9600);
15     dht.begin();
16 }
17
```



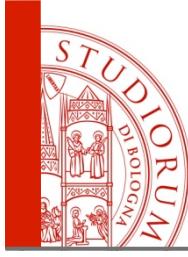
Code

```
20 void loop() {
21     float h = dht.readHumidity();
22     float t = dht.readTemperature();
23
24     while (isnan(h) || isnan(t)) {
25         delay(1000);
26         Serial.println("Failed to read from DHT sensor!");
27         h = dht.readHumidity(true);
28         t = dht.readTemperature(false,true);
29     }
30
31     float hic = dht.computeHeatIndex(t, h, false);
32     Serial.println("*****");
33     Serial.print("Humidity = ");
34     Serial.println(h);
35     Serial.print("Temperature = ");
36     Serial.println(t);
37     Serial.print("Heat Index = ");
38     Serial.println(hic);
39     Serial.println("-----");
40 }
```



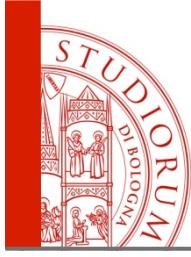
Code

```
41 WiFi.begin(ssid, password);
42 while (WiFi.status() != WL_CONNECTED) {
43     delay(500);
44     Serial.println("Not Connected!");
45 }
46 Serial.println(WiFi.localIP());
47 WiFiClient client;
48
49 if (client.connect("api.thingspeak.com",80)) {
50     String postStr = "3VFBX79MB61MGNNI";
51     postStr += "&field1=";
52     postStr += String(t);
53     postStr += "&field2=";
54     postStr += String(h);
55     postStr += "&field3=";
56     postStr += String(hic);
57     postStr += "\r\n\r\n";
```



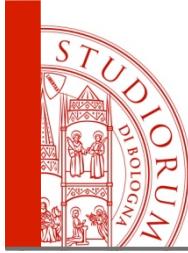
Code

```
59     Serial.println(postStr);  
60  
61     client.print("POST /update HTTP/1.1\n");  
62     client.print("Host: api.thingspeak.com\n");  
63     client.print("Connection: close\n");  
64     client.print("X-THINGSPEAKAPIKEY: 3VFBX79MB61MGNNI\n");  
65     client.print("Content-Type: application/x-www-form-urlencoded\n");  
66     client.print("Content-Length: ");  
67     client.print(postStr.length());  
68     client.print("\n\n");  
69     client.print(postStr);  
70 }  
71  
72 WiFi.disconnect();  
73  
74 delay(10 * 1000);  
75 }
```



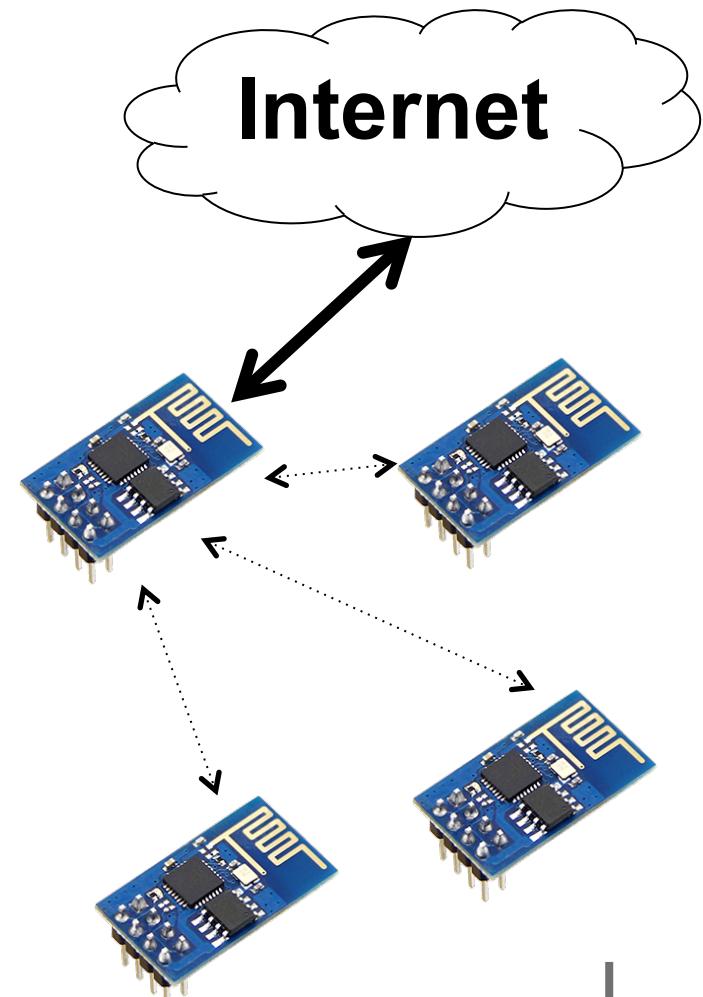
WiFi Scanner

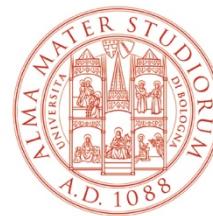
- Let's put up a webserver on the port 80
- Serve a webpage with a list of nearby AP



Autonomous network

- Multiple ESP8266
- The first one will serve as access point and send data to ThingSpeak
- Others will connect to the first ESP8266 and send data to him
- The first one will also display a page showing the devices connected
- If the first one dies, another one will replace it





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