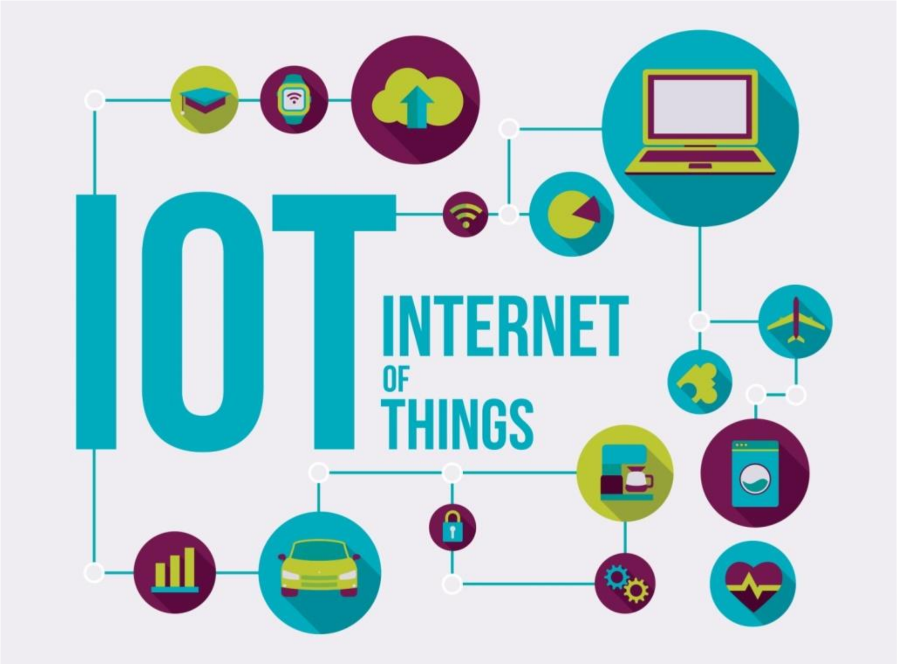
Internet of Things

With trainer : Hamza Awad Hajeir

Introduction

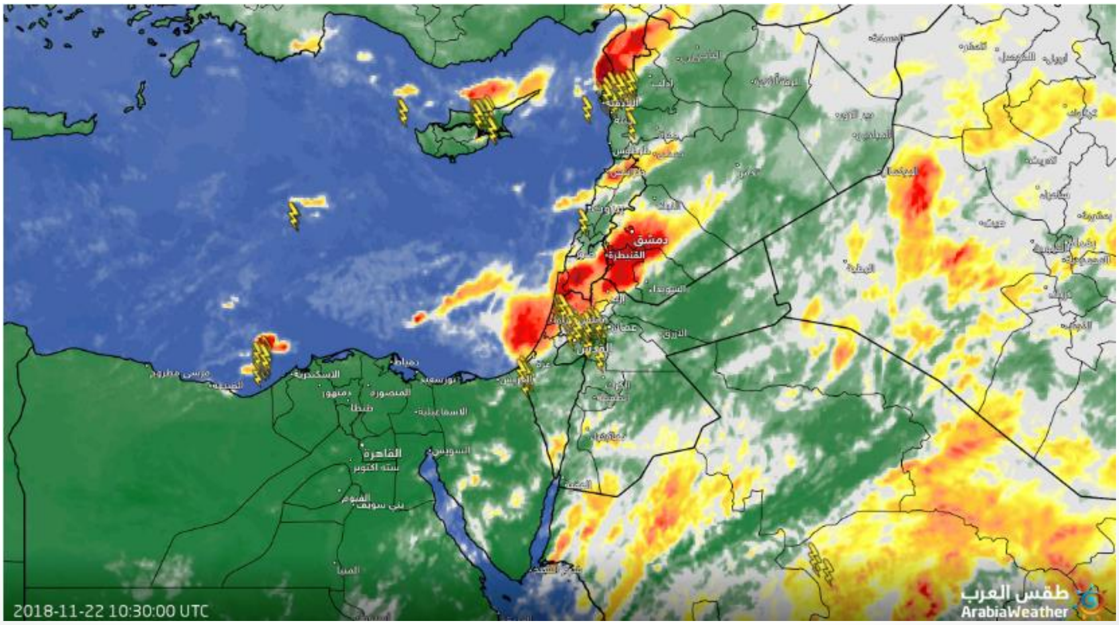
Introduction to IoT

- Internet of Things is the network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data.



Introduction to IoT

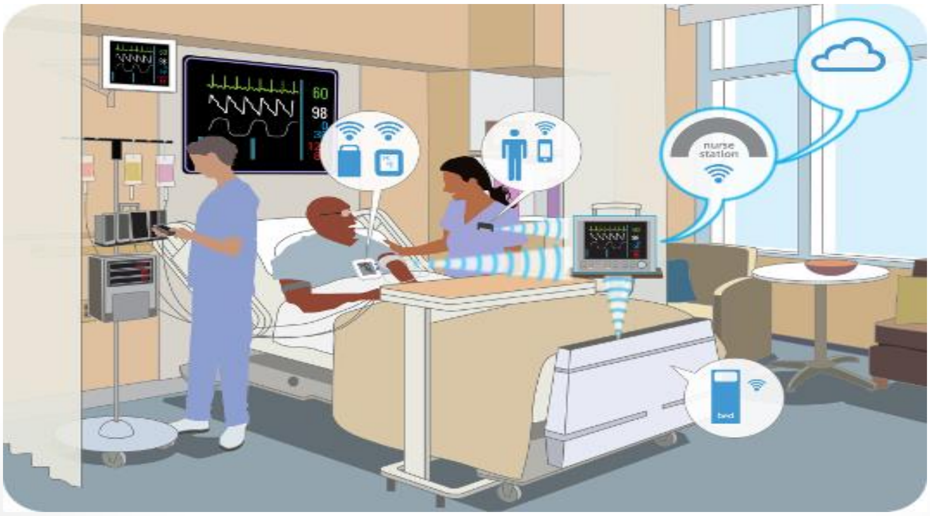
- Arab Weather



Introduction to IoT

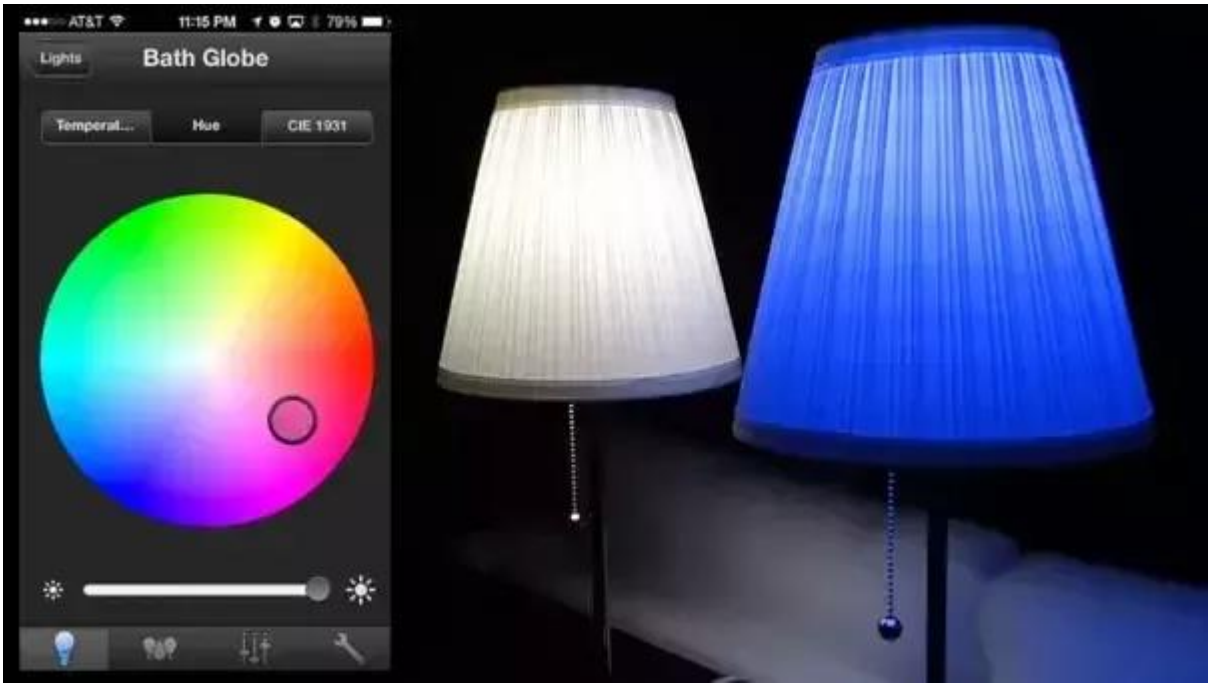
Wearable
Tech

Smart Appliances



Healthcare

Introduction to IoT



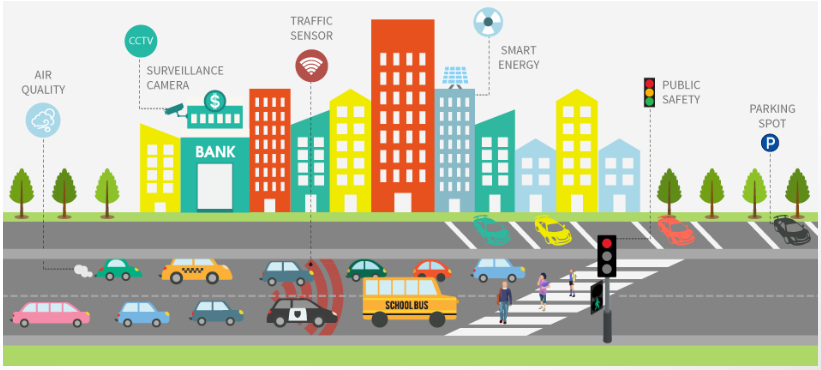
Smart Home

Introduction to IoT

- Home
  - Automation
  - Monitoring

- Health and fitness
  - Patients
  - Players

- City
  - Traffic
  - Security



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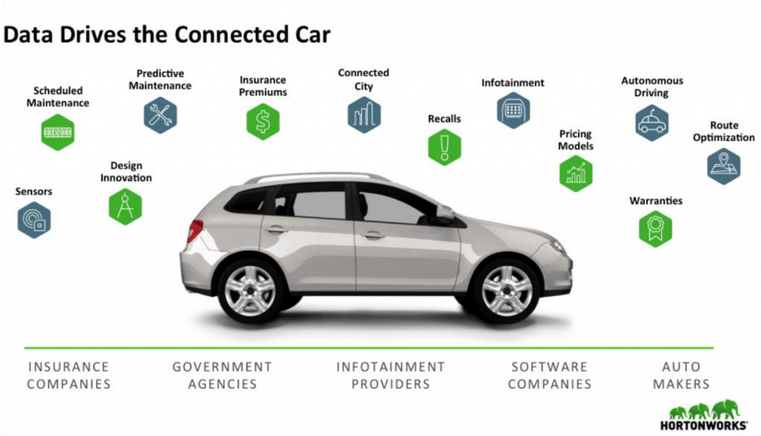
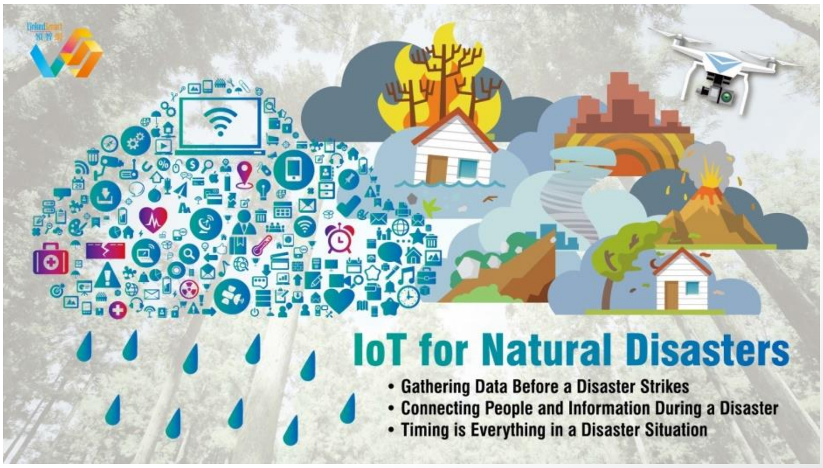
Introduction to IoT

- Connected cars
    - Insurance companies
    - Repair centers

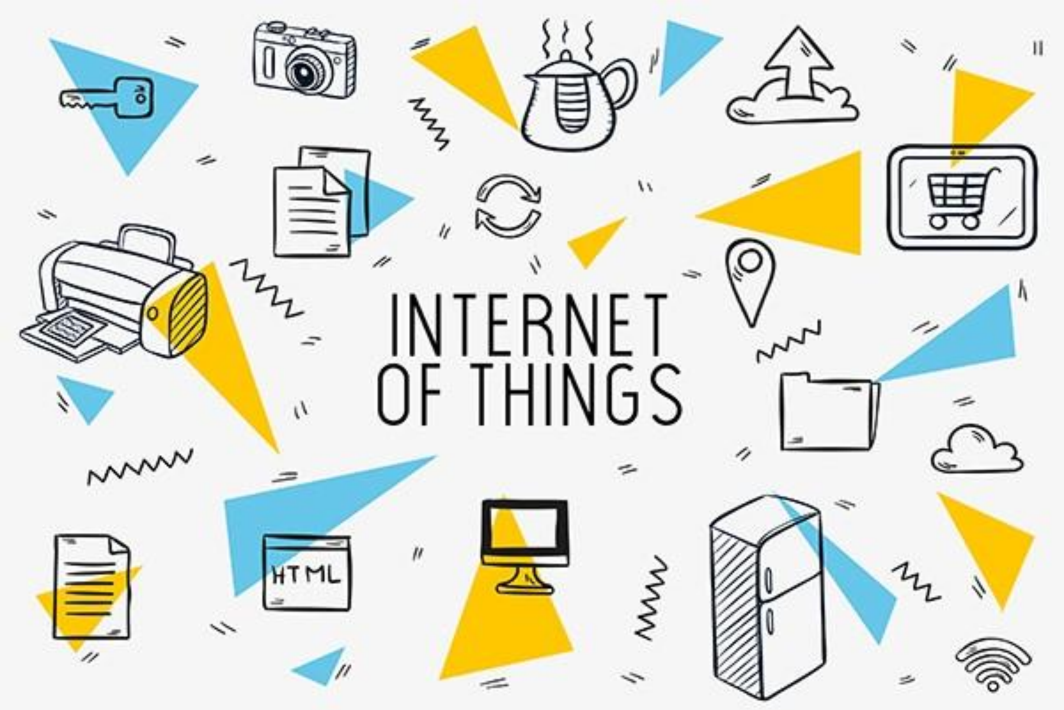


- Environment
    - Global warming
    - Natural disasters
    - Pollution


IoT for Natural Disasters
• Gathering Data Before a Disaster Strikes
• Connecting People and Information During a Disaster
• Timing is Everything in a Disaster Situation

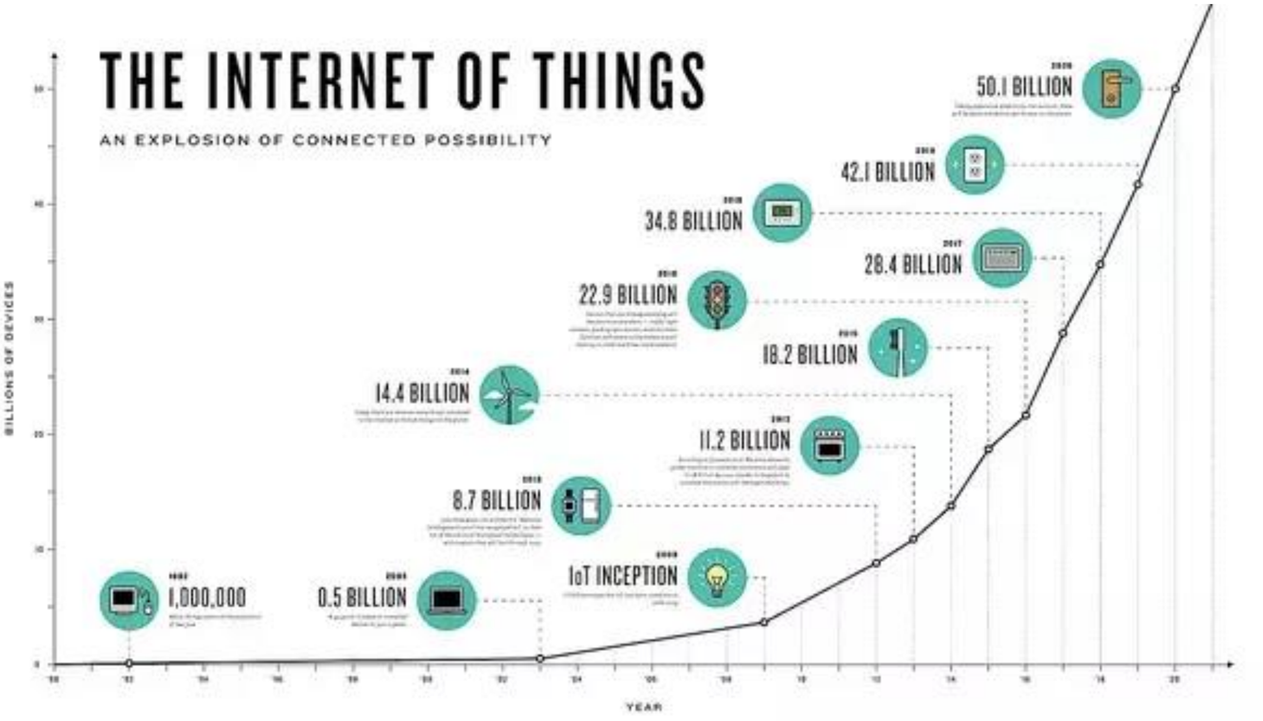
Introduction to IoT

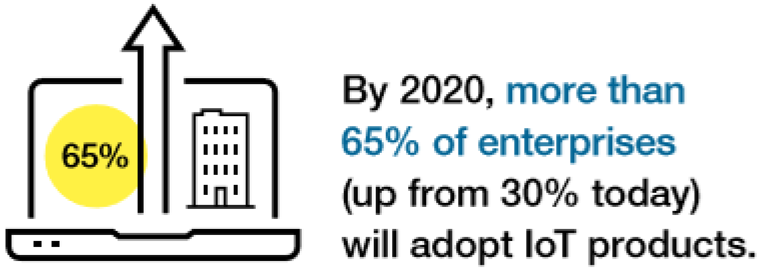
- Home
- Health and fitness
- Business
- City
- Connected Cars
- Environment



Info about IoT field

- Future and Growth of IoT.





By 2020, more than 65% of enterprises (up from 30% today) will adopt IoT products.

Gartner Insights on How to Lead in a Connected World

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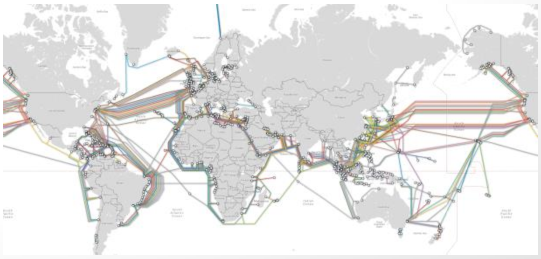
What Is … ?
Internet of Things

- What is Internet ?

- Is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers).



What Is … ?
Internet of Things

- What Are Things ?

  Sensors

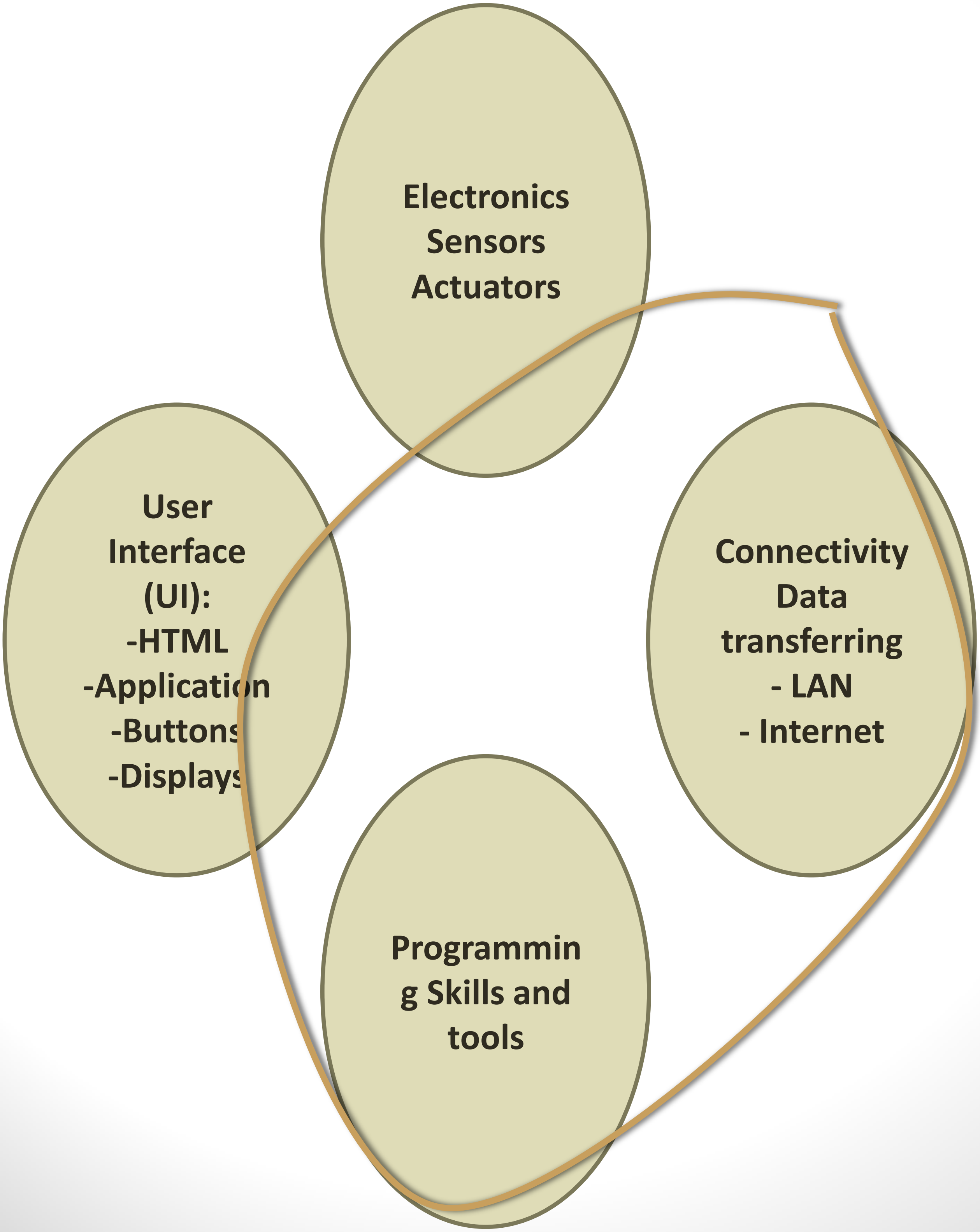
  Actuators

  Electronic parts

  Embedded with Microcontroller,
  Which is a Tiny Computer.

  - “how computer works video”

IoT Overview



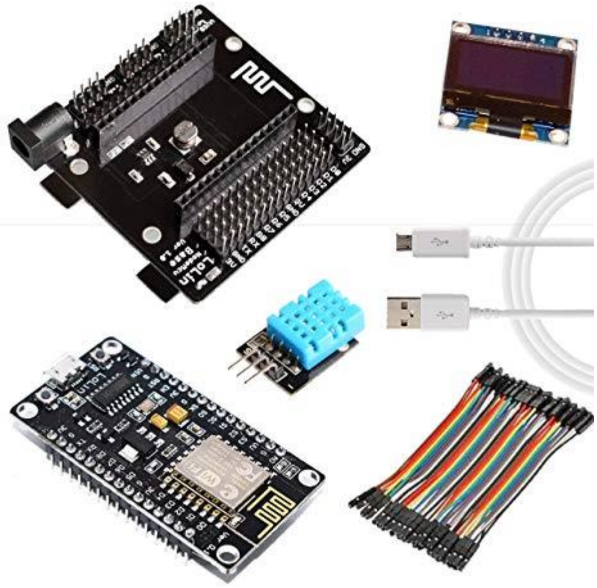
Electronics
Sensors
Actuators

User Interface (UI):
-HTML
-Application
-Buttons
-Displays

Connectivity
Data transferring
- LAN
- Internet

Programming Skills and tools

Let’s go!



Installation

- Arduino IDE

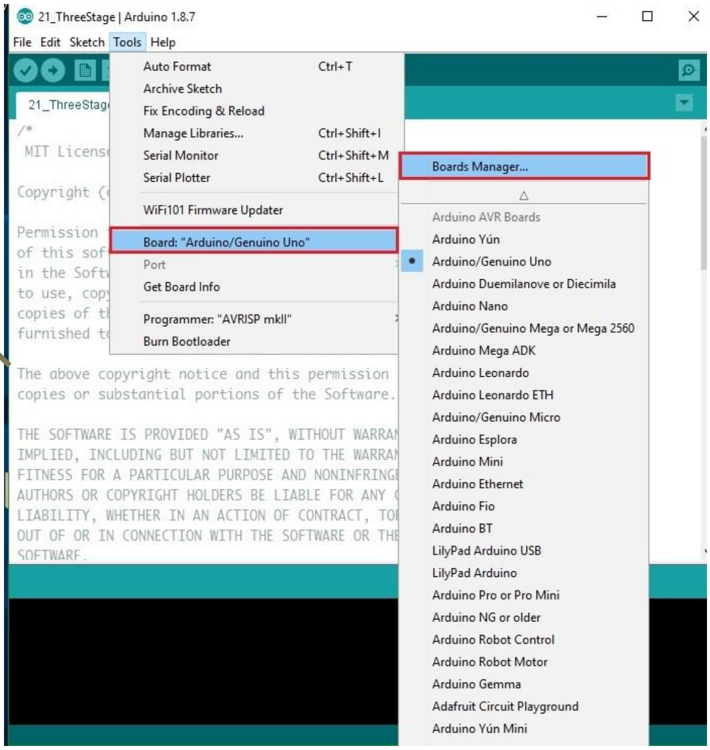
AN OPEN PROJECT WRITTEN, DEBUGGED, AND SUPPORTED BY ARDUINO.CC AND THE ARDUINO COMMUNITY WORLDWIDE

LEARN MORE ABOUT THE CONTRIBUTORS OF ARDUINO.CC on arduino.cc/credits

Installation

- Arduino IDE
- ESP8266 core

1



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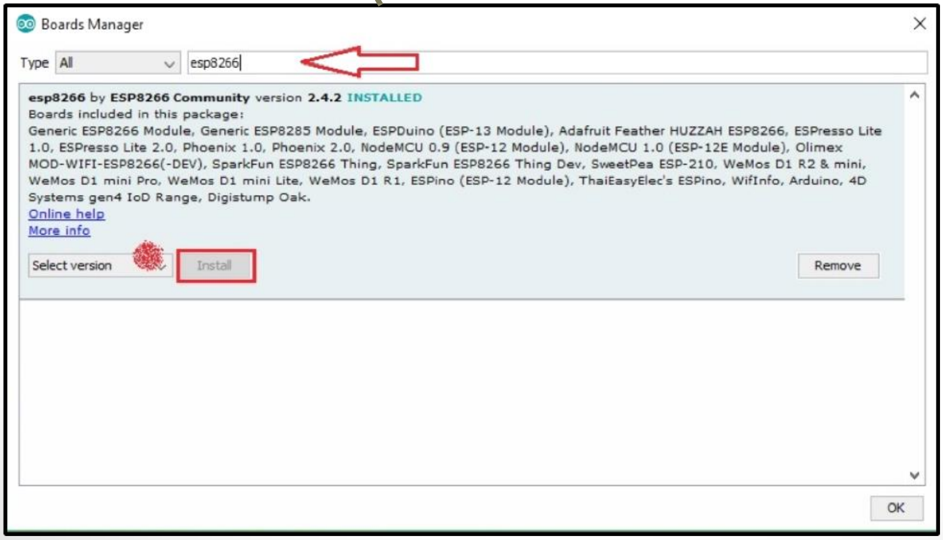
```

2

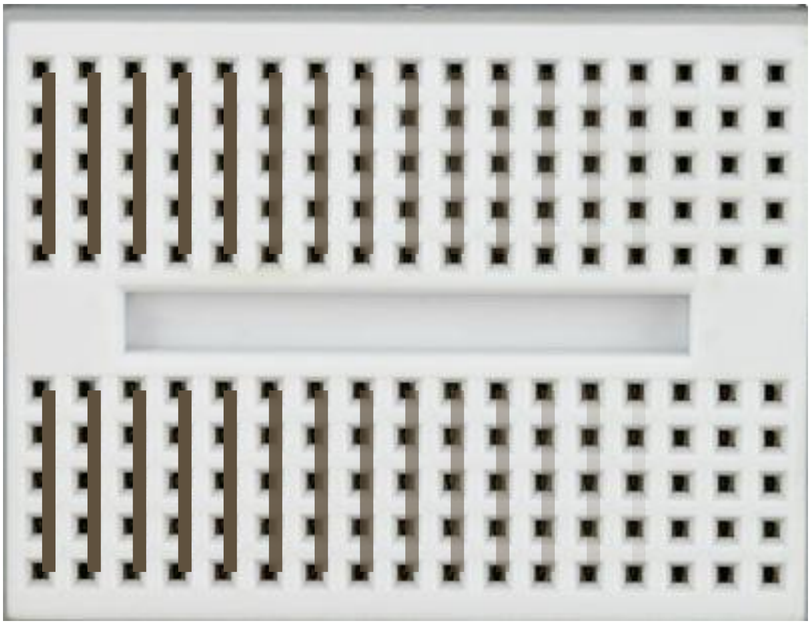


esp8266

esp8266 by **ESP8266 Community** version **2.4.2** INSTALLED
Boards included in this package:
Generic ESP8266 Module, Generic ESP8285 Module, ESPDuino (ESP-13 Module), Adafruit Feather HUZZAH ESP8266, ESPresso Lite 1.0, ESPresso Lite 2.0, Phoenix 1.0, Phoenix 2.0, NodeMCU 0.9 (ESP-12 Module), NodeMCU 1.0 (ESP-12E Module), Olimex MOD-WIFI-ESP8266(-DEV), SparkFun ESP8266 Thing, SparkFun ESP8266 Thing Dev, SweetPea ESP-210, WeMos D1 R2 & mini, WeMos D1 mini Pro, WeMos D1 mini Lite, WeMos D1 R1, ESPino (ESP-12 Module), ThaiEasyElec's ESPino, WifInfo, Arduino, 4D Systems gen4 IoD Range, Digistump Oak.
Online help
More info

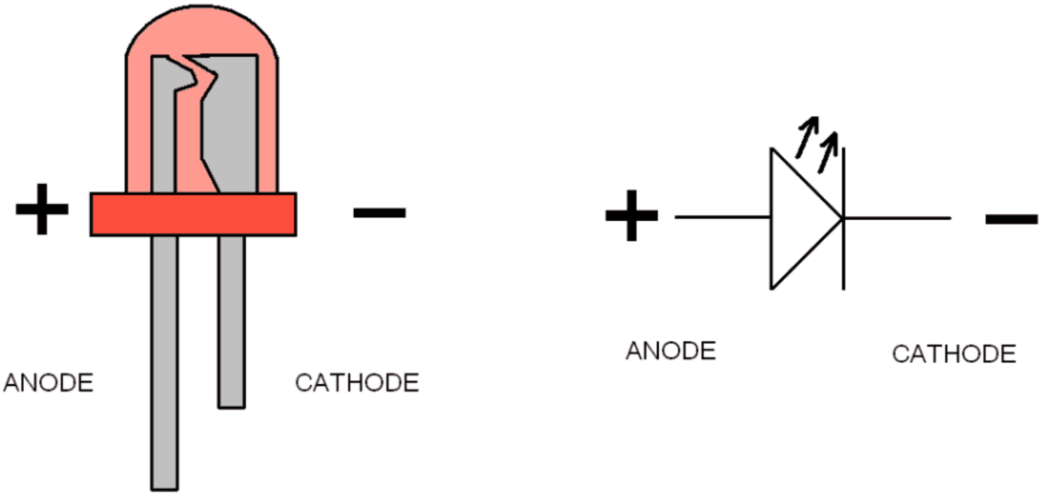
Electronics and Wiring

- Bread board



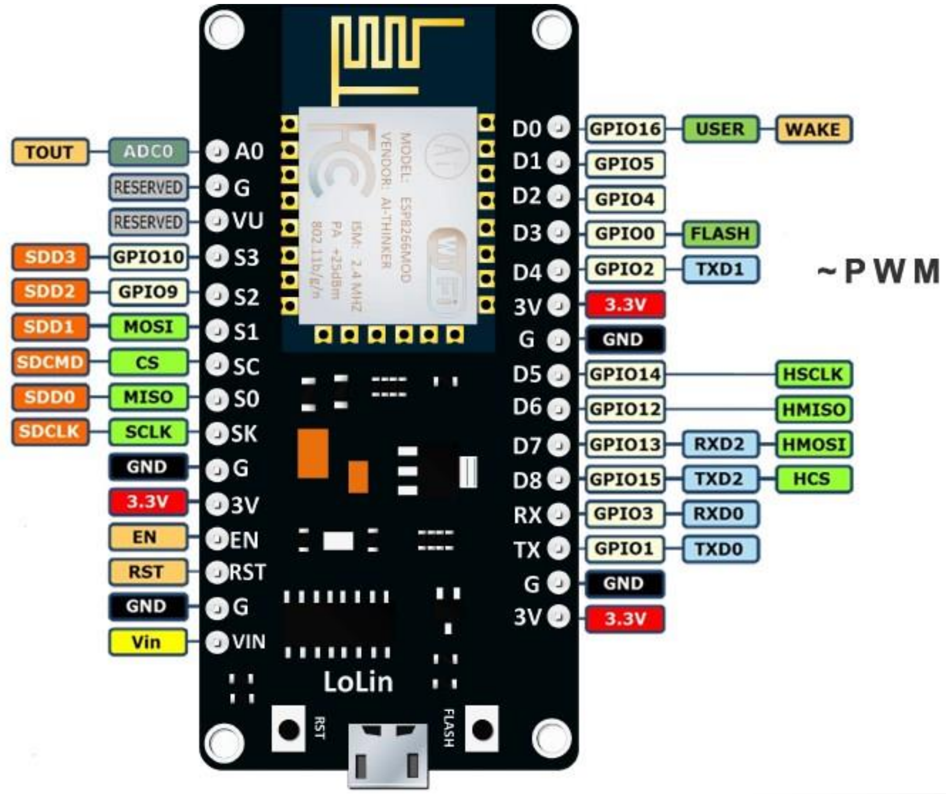
Electronics and Wiring

- Bread board
- LEDs



Electronics and Wiring

- Bread board
- LEDs
- ESP8266 NodeMCU pin map



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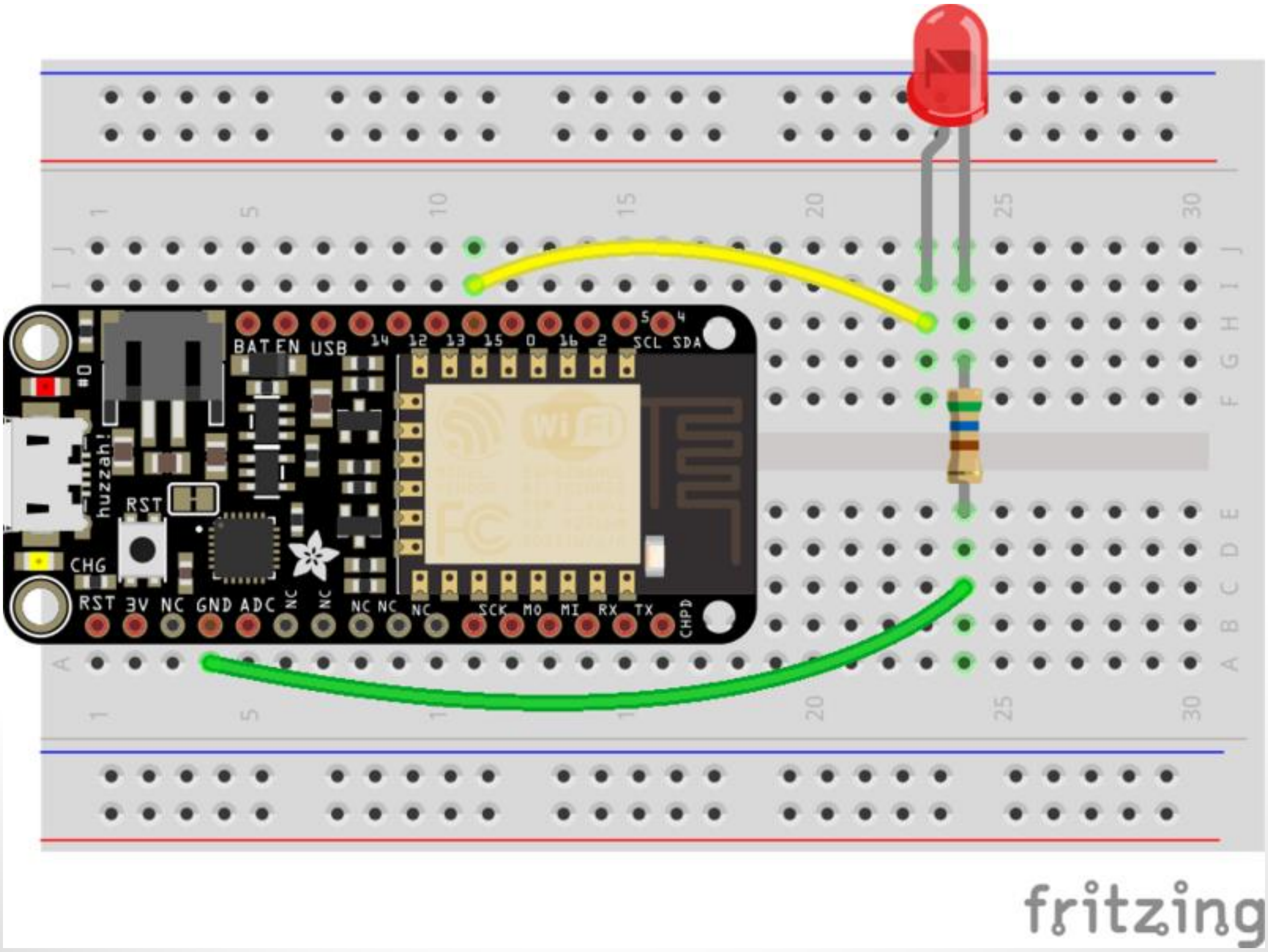
Electronics and Wiring

Circuit wiring



BAT EN USB 14 12 13 15 0 16 2 SCL SDA
5 4
#0
huzzah!
RST
CHG
RST 3V NC GND ADC NC NC NC NC NC SCK MO MI RX TX CHPD
1 5 10 15 20 25 30
J I H G F E D C B A
fritzing

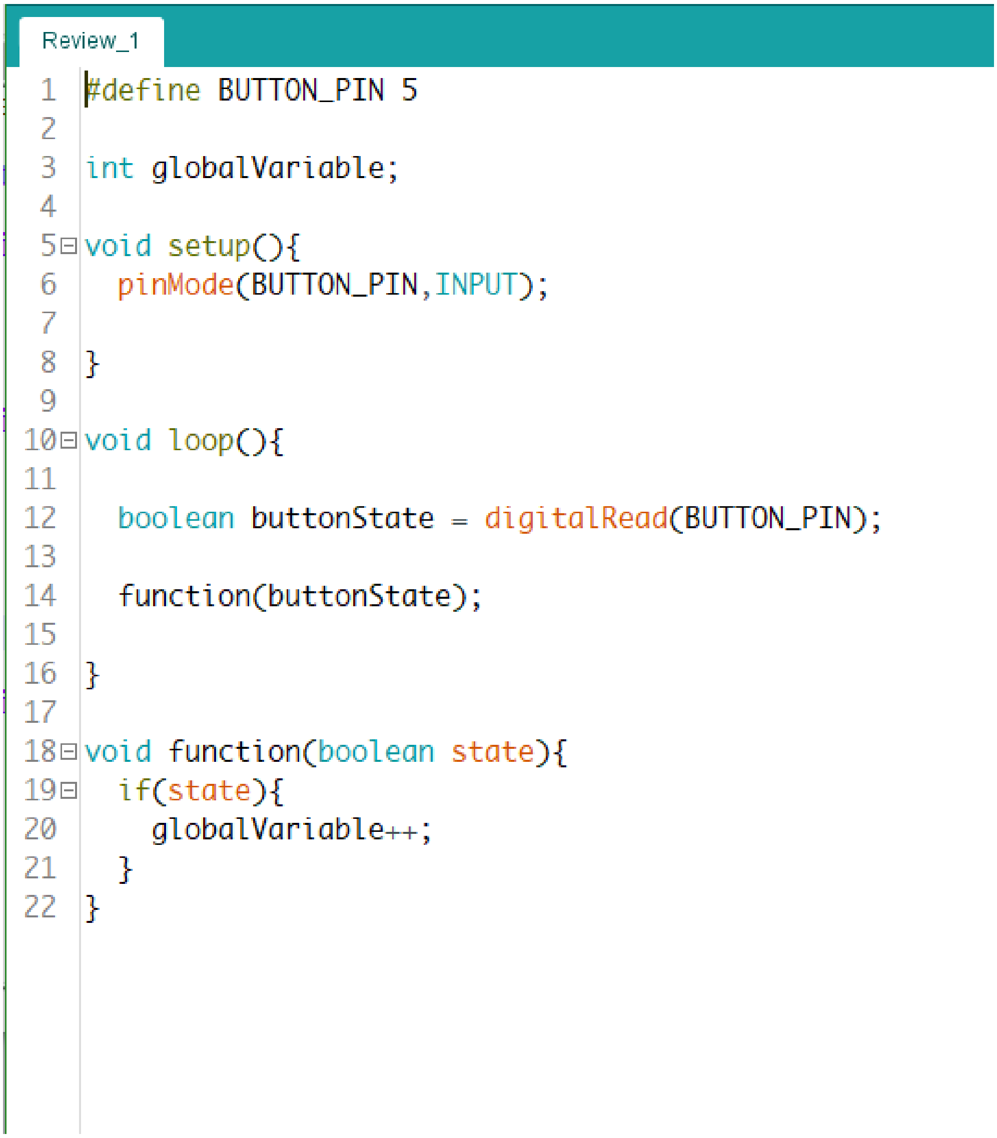
Arduino basics recap

- digitalRead(7);
- digitalWrite(5,HIGH);
- analogRead(A0);
- analogWrite(11,200);

- Serial.begin(9600);
- Serial.print(“”);
  Serial.println(“”);

- Fucntions.

Arduino basics recap



```
#define BUTTON_PIN 5

int globalVariable;

void setup(){
  pinMode(BUTTON_PIN,INPUT);

}

void loop(){

  boolean buttonState = digitalRead(BUTTON_PIN);

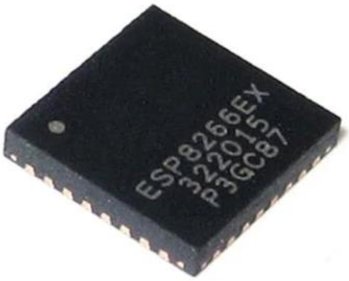
  function(buttonState);

}

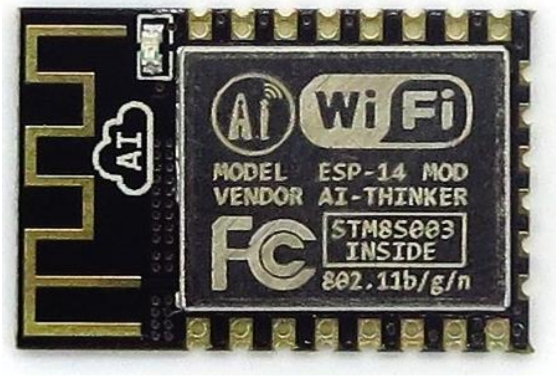
void function(boolean state){
  if(state){
    globalVariable++;
  }
}
```

About ESP8266

- **Chip**
- Module
  - Flash memory
  - Antenna
- **ESP-01**
- **NodeMCU**
  - 3.3 V regulator
  - USB to TTL



ESP8266ex



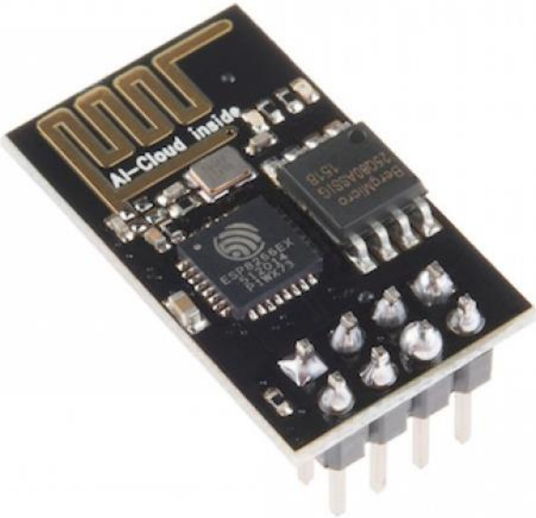
ESP-14

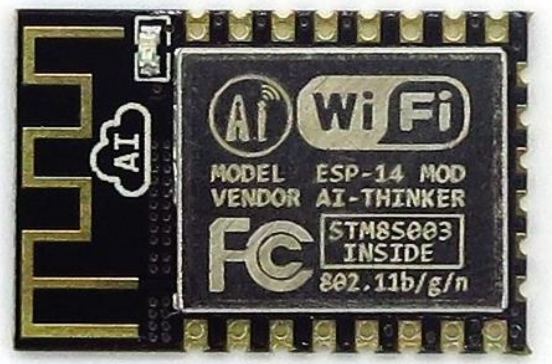
NodeMCU

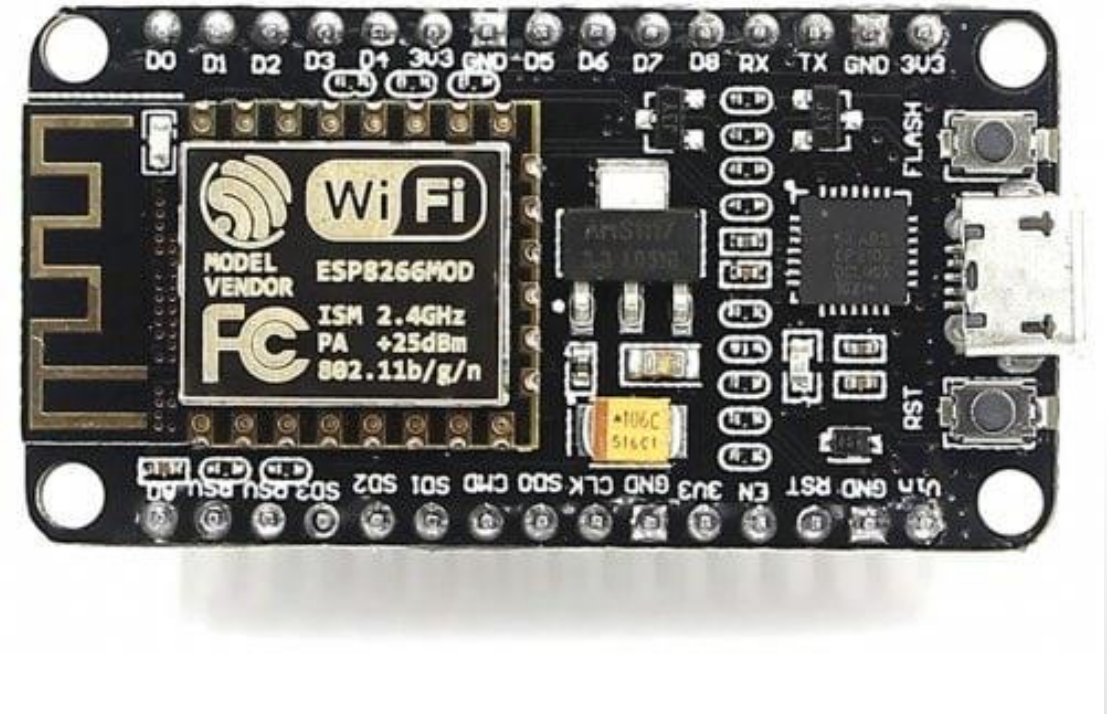
ESP-01

On a scale

ESP8266EX


AI-Cloud inside
ESP8266EX


AI
Wi Fi
MODEL ESP-14 MOD
VENDOR AI-THINKER
FC
STM8S003 INSIDE
802.11b/g/n


D0 D1 D2 D3 D4 3V3 GND D5 D6 D7 D8 RX TX GND 3V3
Wi Fi
MODEL
VENDOR
ESP8266MOD
FC
ISM 2.4GHz
PA +25dBm
802.11b/g/n
FLASH
RST
A0 RSV RSV SD3 SD2 SD1 CMD SDO CLK GND 3V3 EN RST GND Vin

Course

Beginning with ESP8266

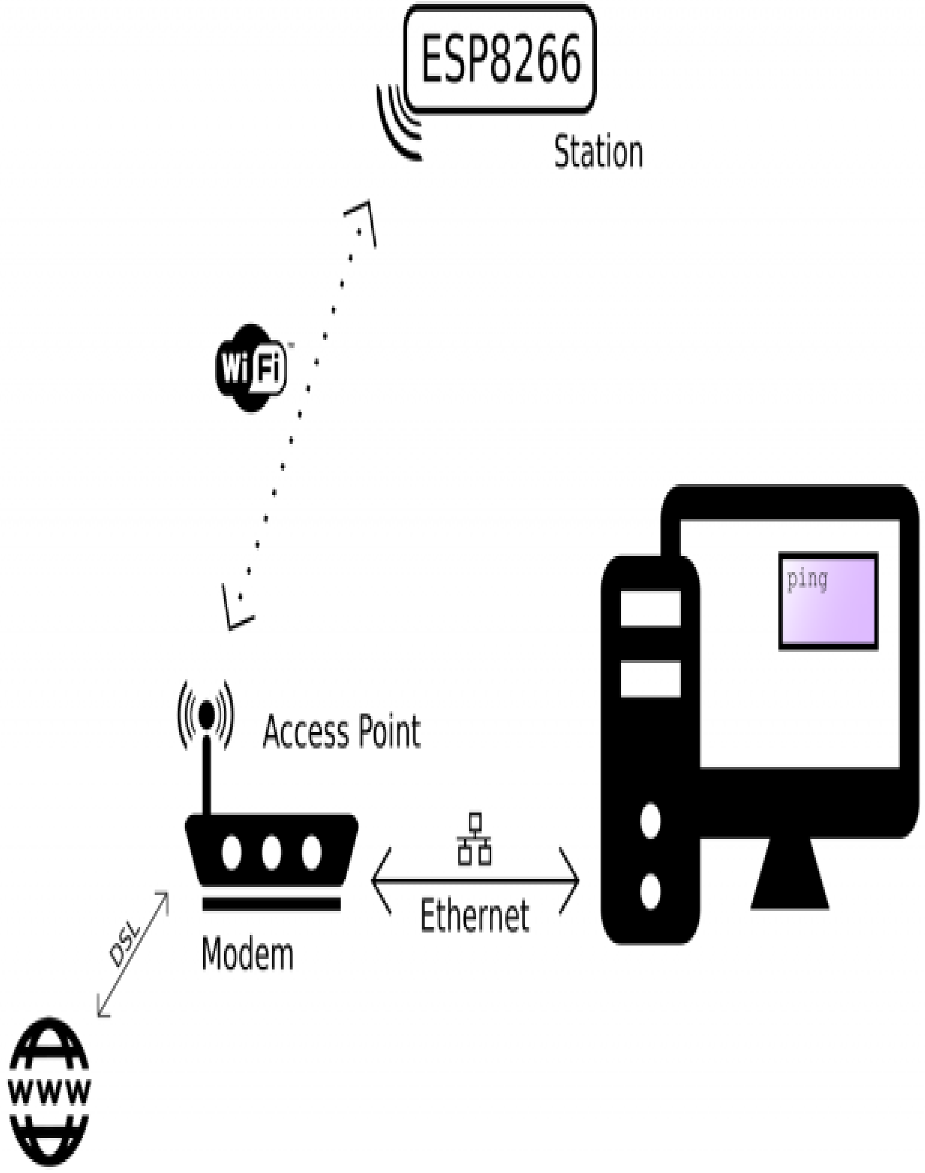
- **Install board :**
  - Add link to Preferences -> Additional Boards
  - Go to Tools -> Board -> Boards Manager and install esp8266

- **Blink** :
  - Open File -> Examples -> Blink
  - Select “NodeMCU 1.0” from Tools -> Board:
  - Hit Upload.

Beginning with ESP8266

- **Install board.**
- **Blink.**
- **Connect :**
  - ESP8266WIFI.h
  - WiFi.begin(SSID,password)
  - while(WiFi.status() != WL_CONNECTED)
  - Obtain IP Address
  - ping
    - Ping ESP's local IP
    - Ping google.com

Beginning with ESP8266



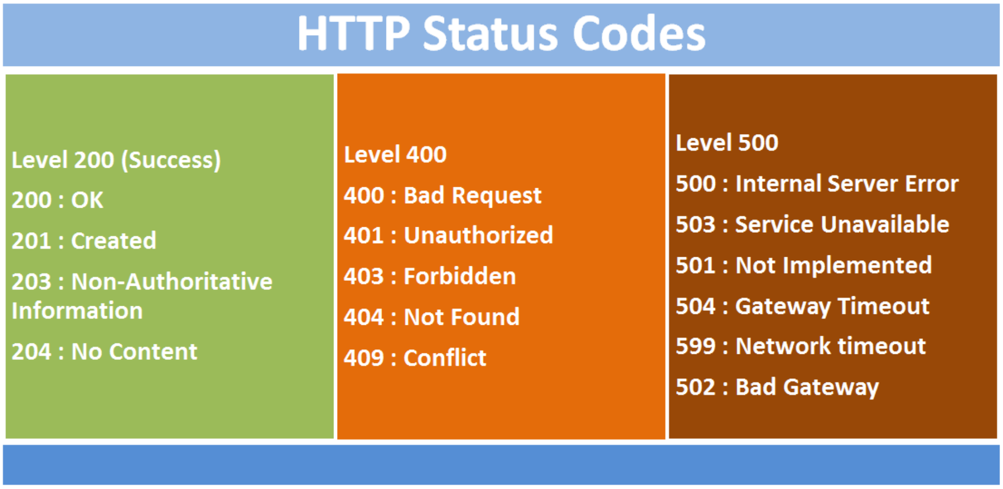
Connecting over LAN

- We’re setting a WebServer.
  - “Story explains server.”
  - Serve , Service , Server.

  - **Create a simple server**
    - **1-simple server’s response due to “link” call:**
      - **Local IP/message**

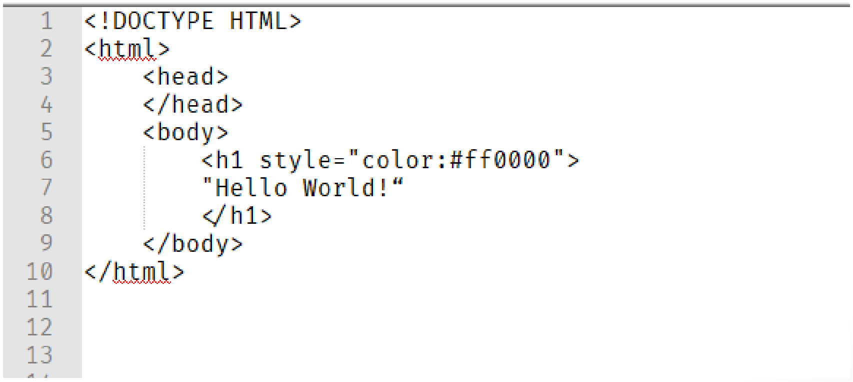
Connecting over LAN

- Create a simple server
  - 1-simple server’s response due to “link” call.
  - **2- simple server’s code “Hello World”:**
    - **HTTP responses**
    - **HTML code**



HTTP Status Codes

Level 200 (Success)	Level 400	Level 500
200 : OK	400 : Bad Request	500 : Internal Server Error
201 : Created	401 : Unauthorized	503 : Service Unavailable
203 : Non-Authoritative Information	403 : Forbidden	501 : Not Implemented
204 : No Content	404 : Not Found	504 : Gateway Timeout
	409 : Conflict	599 : Network timeout
		502 : Bad Gateway



```
<!DOCTYPE HTML>
<html>
    <head>
    </head>
    <body>
        <h1 style="color:#ff0000">
        "Hello World!“
        </h1>
    </body>
</html>
```

Connecting over LAN

- Create a simple server
  - 1-simple server’s response due to “link” call.
  - 2- simple server’s code “Hello World”.
  - **3- simple HTML constructor :**
    - **Easy tool to design a HTML page.**
    - **Assign it to Arduino String variable.**

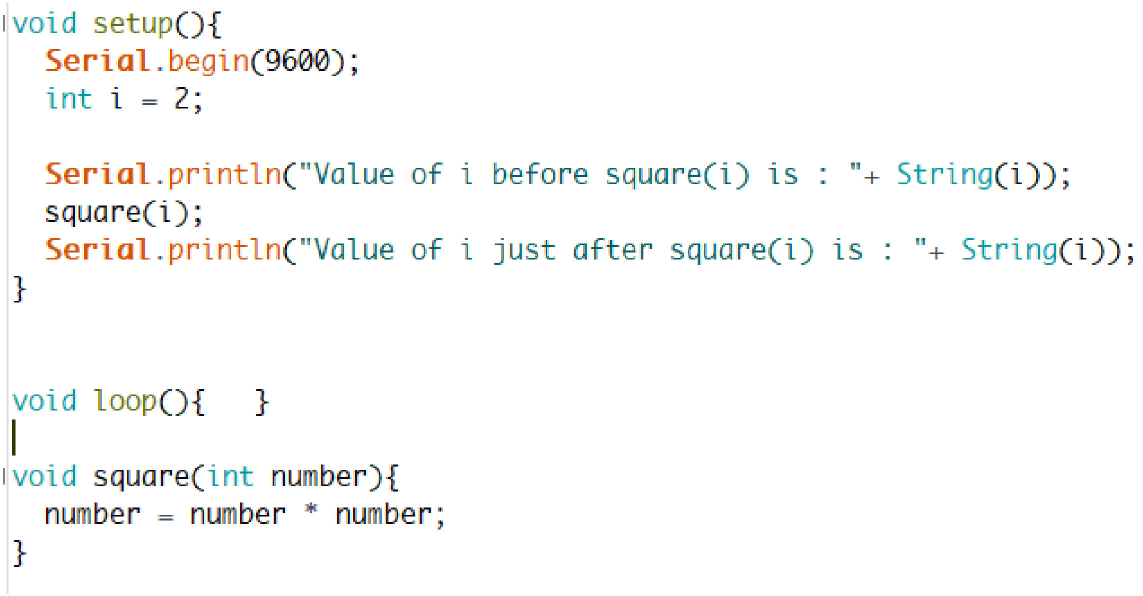
Connecting over LAN

- Create a simple server
  - 1-simple server’s response due to “link” call.
  - 2- simple server’s code “Hello World”
  - 3- simple HTML constructer.
  - **4- simple Android Application.**

Coding Essentials

- **Pointers:**

Without Pointer :



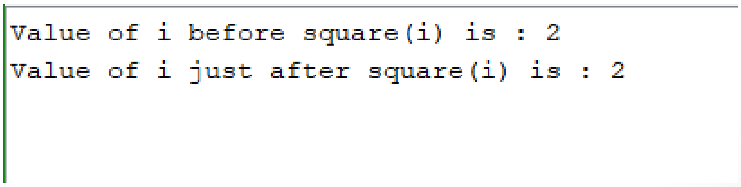
```
void setup(){
  Serial.begin(9600);
  int i = 2;

  Serial.println("Value of i before square(i) is : "+ String(i));
  square(i);
  Serial.println("Value of i just after square(i) is : "+ String(i));
}


void loop(){   }

void square(int number){
  number = number * number;
}
```

Serial monitor :

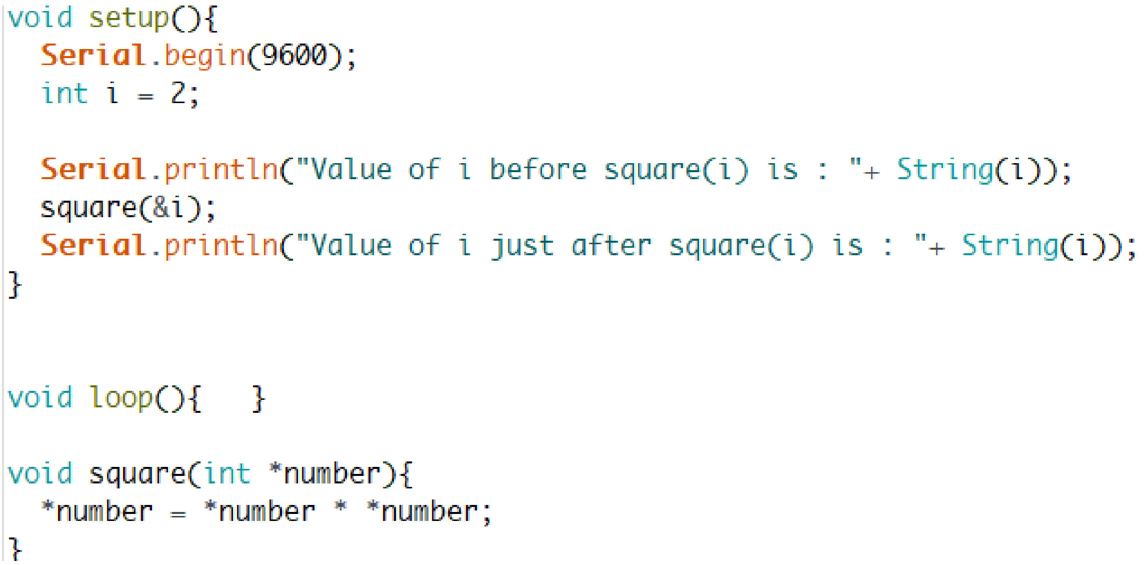


```
Value of i before square(i) is : 2
Value of i just after square(i) is : 2
```

Coding Essentials

- **Pointers:**

With Pointer :



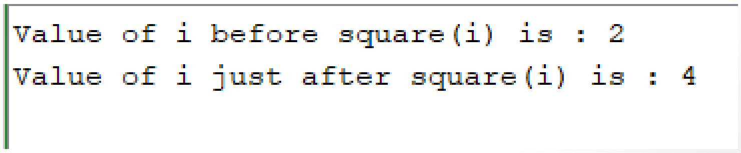
```
void setup(){
  Serial.begin(9600);
  int i = 2;

  Serial.println("Value of i before square(i) is : "+ String(i));
  square(&i);
  Serial.println("Value of i just after square(i) is : "+ String(i));
}


void loop(){   }

void square(int *number){
  *number = *number * *number;
}
```

Serial monitor :



```
Value of i before square(i) is : 2
Value of i just after square(i) is : 4
```

Coding Essentials

- Pointers.
- **millis():**
  - **Returns the time since board had power on.**
  - **(unsigned long) data type.**

Coding Essentials

- Pointers.
- millis().
- **Ticker:**
  - Ticker library is a good alternative of timing instead of delay or millis() functions.
  - Repeat forever
  - Or once.

Coding Essentials

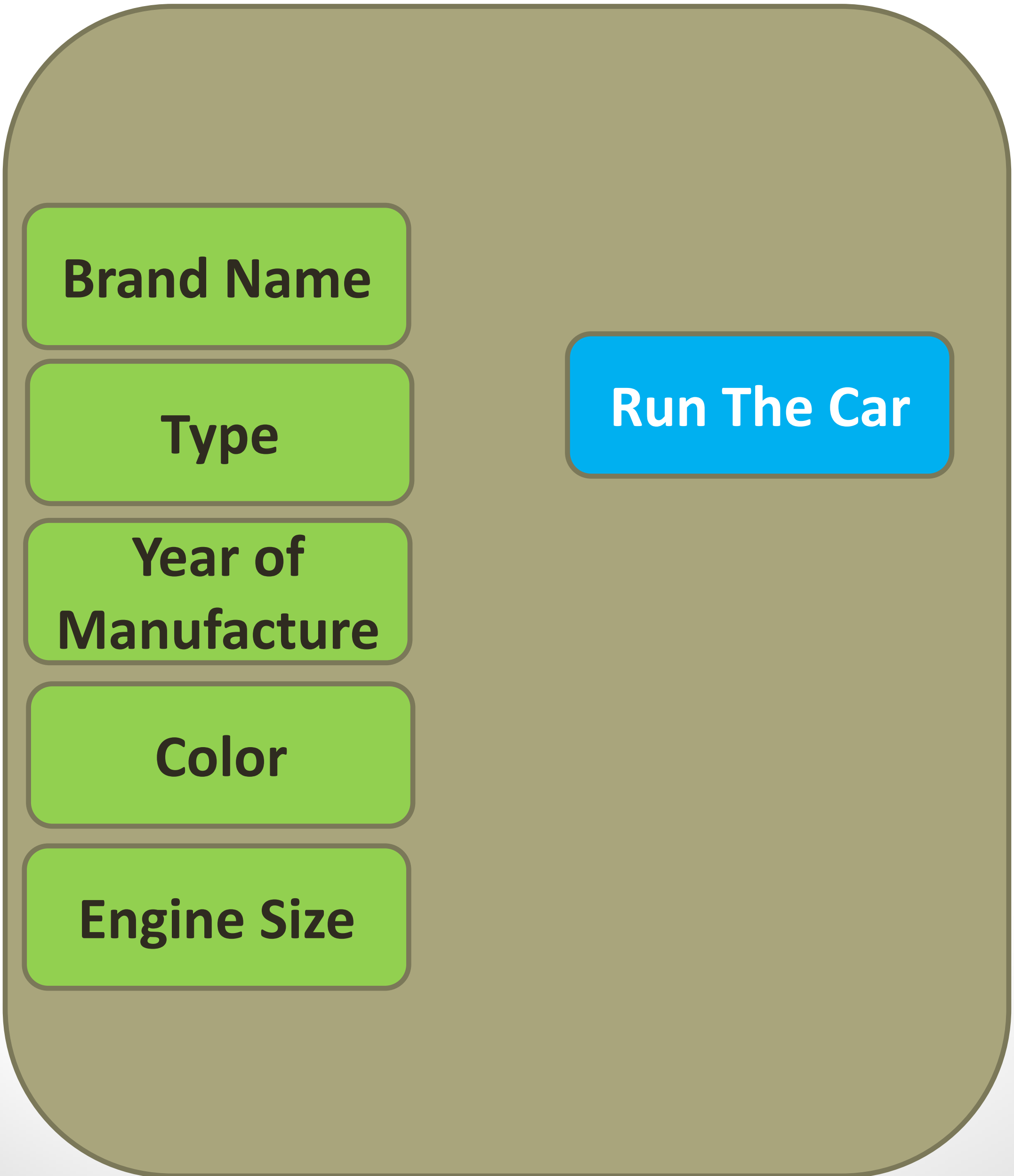
- Pointers.
- millis().
- Ticker.
- **Interrupt:**

Coding Essentials

- **OOP (Object Oriented Programming)**

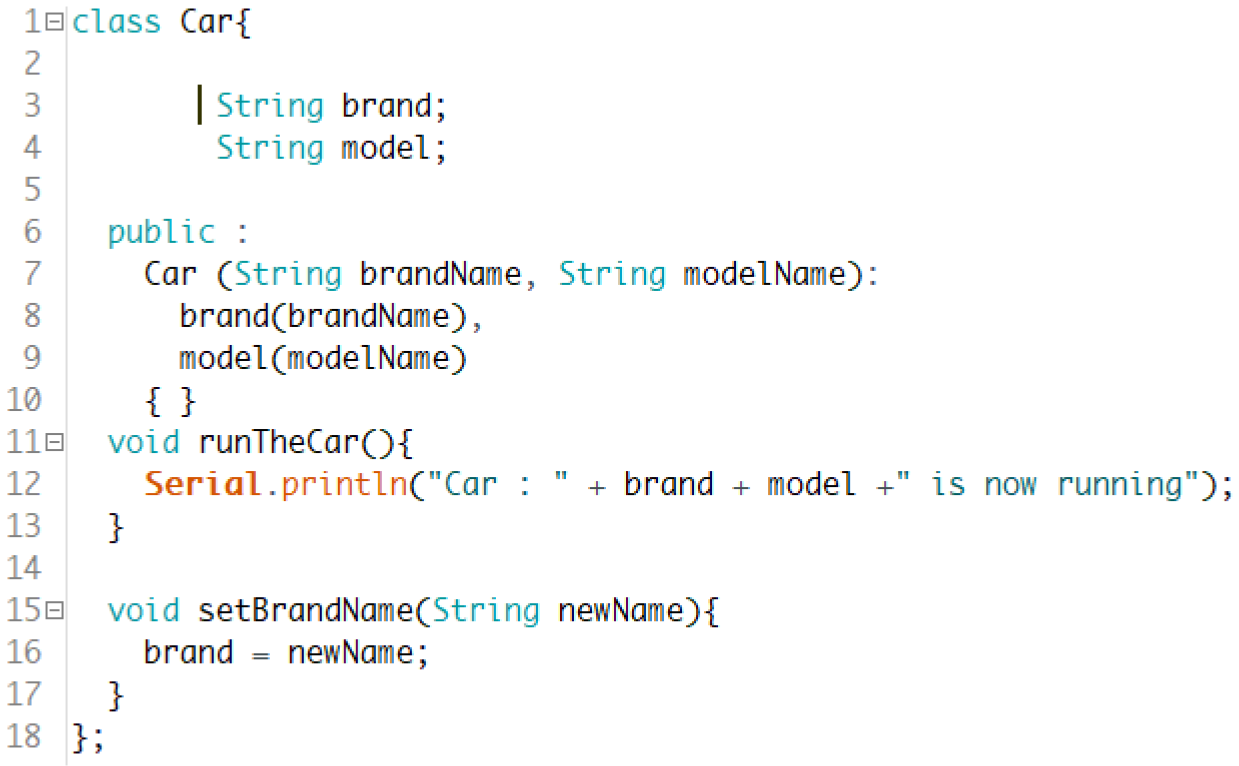
Coding Essentials

- OOP (Object Oriented Programming)
- **Class :**



Coding Essentials

- OOP (Object Oriented Programming)
- **Class :**



```
class Car{

        String brand;
        String model;

  public :
    Car (String brandName, String modelName):
      brand(brandName),
      model(modelName)
    { }
  void runTheCar(){
    Serial.println("Car : " + brand + model +" is now running");
  }

  void setBrandName(String newName){
    brand = newName;
  }
};
```

OOP_Starter_code

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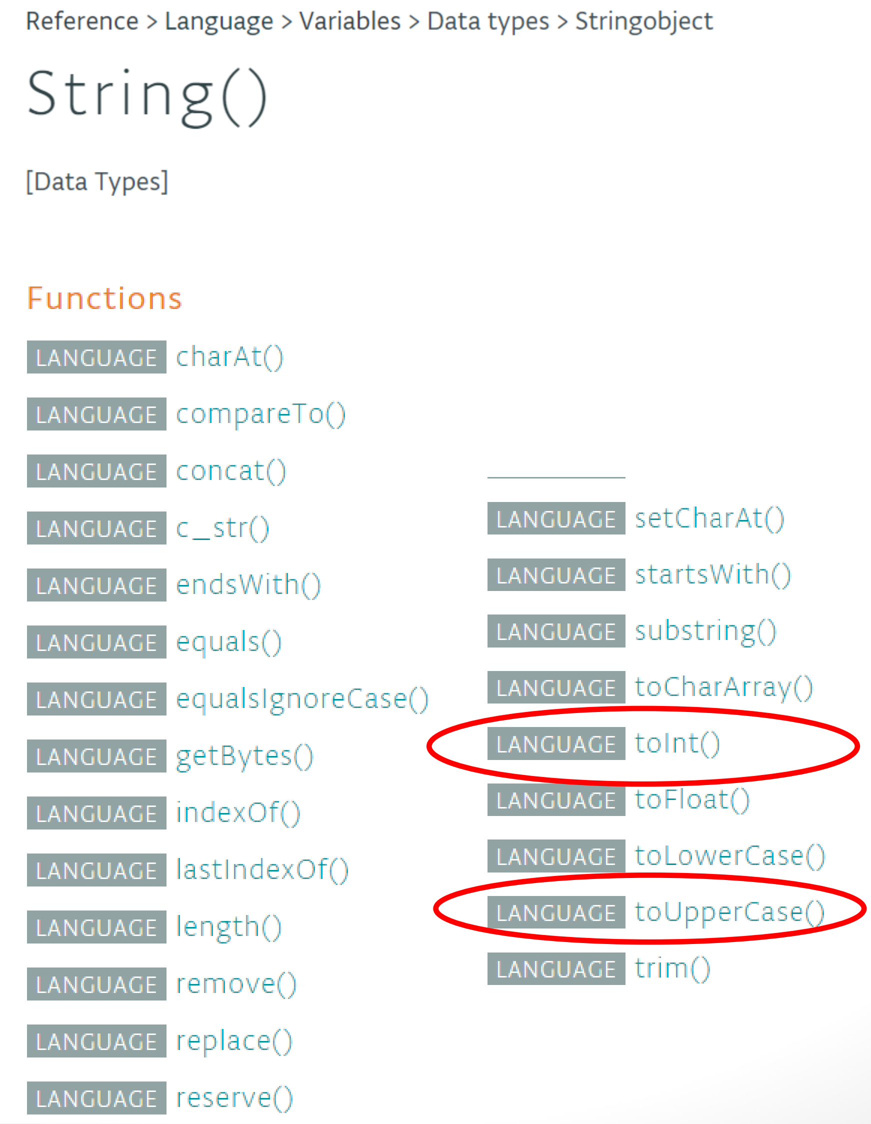
Coding Essentials

- OOP (Object Oriented Programming).
- Class.
- **Arduino String class:**



Reference > Language > Variables > Data types > Stringobject

String()

[Data Types]

Functions

LANGUAGE charAt()

LANGUAGE compareTo()

LANGUAGE concat()

LANGUAGE c_str()

LANGUAGE endsWith()

LANGUAGE equals()

LANGUAGE equalsIgnoreCase()

LANGUAGE getBytes()

LANGUAGE indexOf()

LANGUAGE lastIndexOf()

LANGUAGE length()

LANGUAGE remove()

LANGUAGE replace()

LANGUAGE reserve()

LANGUAGE setCharAt()

LANGUAGE startsWith()

LANGUAGE substring()

LANGUAGE toCharArray()

LANGUAGE toInt()

LANGUAGE toFloat()

LANGUAGE toLowerCase()

LANGUAGE toUpperCase()

LANGUAGE trim()

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Connecting over cloud

- ThingSpeak Platform
  - Platforms :
    - Carriot
    - Sensorsiot
  - is a group of technologies that are used as a base upon which other applications, processes or technologies are developed.
- Thingspeak Library

ESP8266 Special cases

- WDT Watch Dog Timer
  - Soft WDT specs:
  - Use of delay(0) or yield().
  - Blocking function like :
    - While(true);
    - delay()

MQTT

- MQTT Idea :
- MQ TT name :
- MQTT is a Protocol.

- MQTT consists of :
  - Broker
  - Topics
  - Subscriber
  - Publisher
- MQTT cloud
- pubsubclient library
- MQTT Lens chrome extention