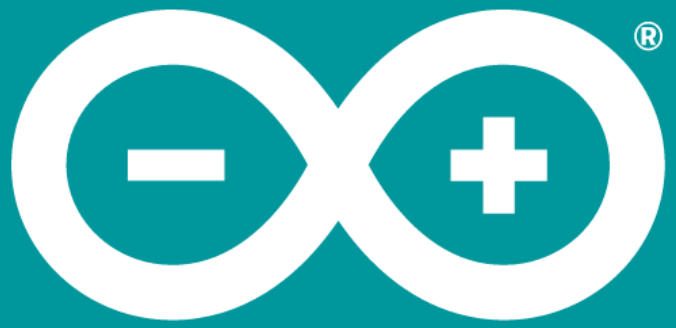


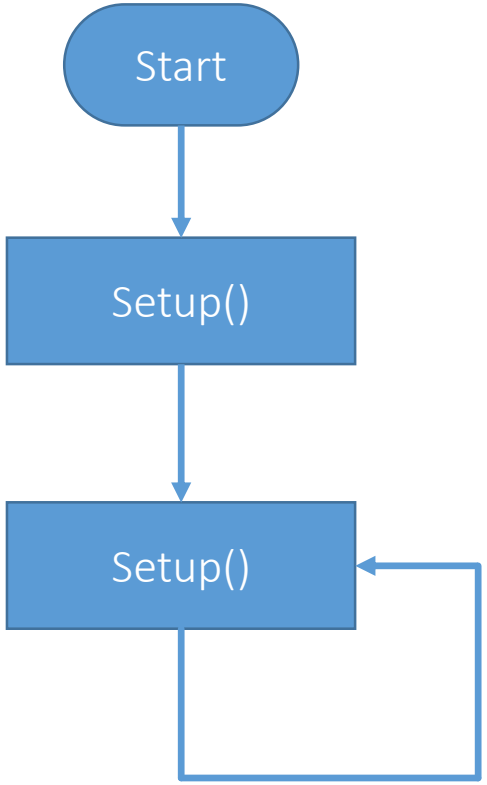
Let’s Arduino!

Part III – Language and Library

/* Fei Cheng */

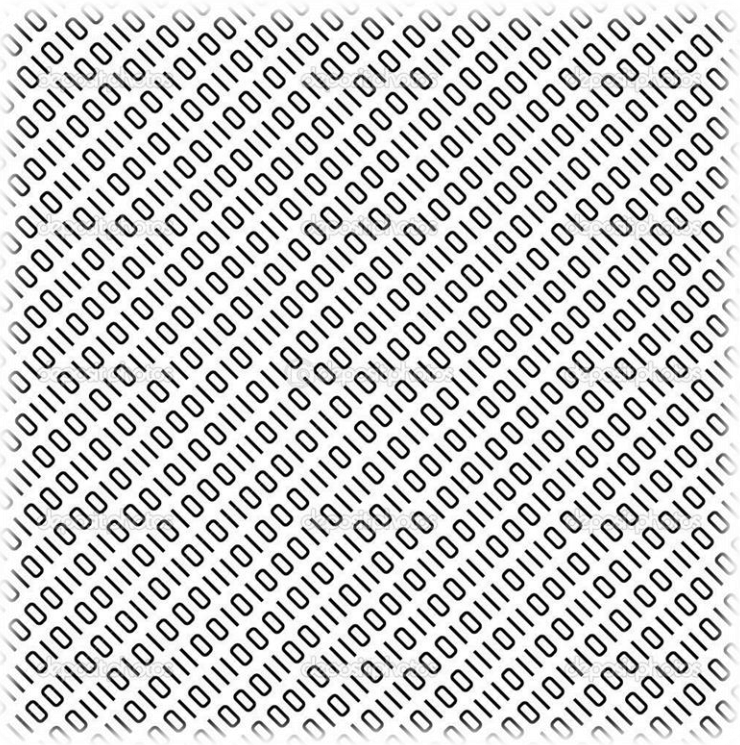
Language

- Basic program structure
  - setup()
    - The setup() function is called when a sketch starts. Use it to initialize variables, pin modes, start using libraries, etc. The setup function will only run once, after each power-up or reset of the Arduino board.
  - loop()
    - After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.



Language

- Control Structures (similar to C/C++ language)
  - `if / if…else`
  - `switch case`
  - `for loop`
  - `while loop`
  - `do while loop`
  - `break`
  - `continue`



Language

- if / if…else / else if

```
if ( condition )
{
    //action A
}
```

```
if ( condition )
{
    //action A
}
else
{
    //action B
}
```

```
if ( condition1 )
{
    //action A
}
else if ( condition2 )
{
    //action B
}
else
{
    //action C
}
```

Language

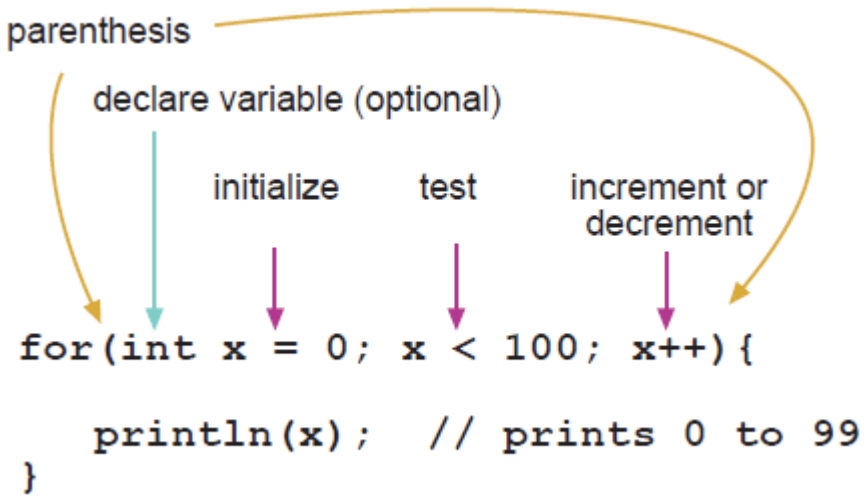
- switch case

```
switch (var)
{
    case label:
        // statements
        break;
    case label:
        // statements
        break;
    default:
        // statements
        break;
}
```

Language

- for loop

```
for (initialization; condition; increment)
{
    //statements;
}
```



Language

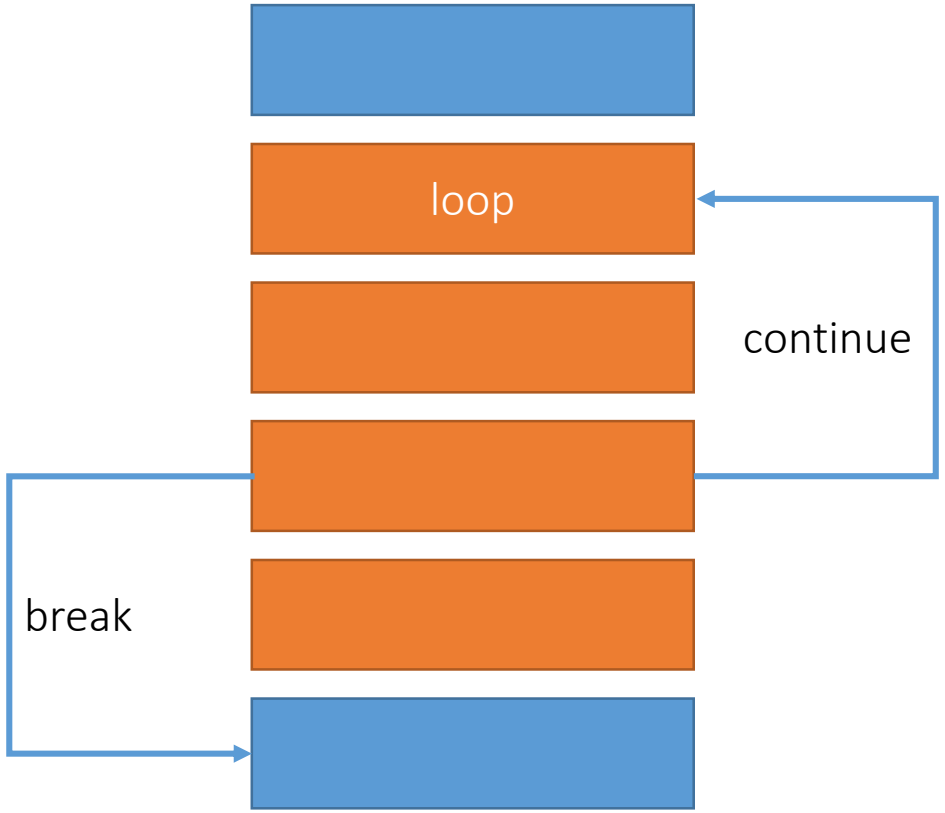
- while loop and do…while loop

```
while( condition )
{
   // statement block
}
```

```
do
{
    // statement block
} while ( condition );
```

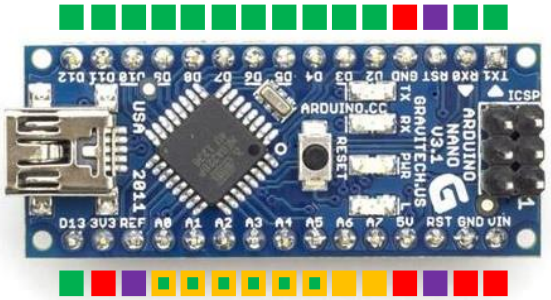
Language

- break:
  - exit from a for, while, do…while loop
  - exit from a switch statement
- continue:
  - Skip the rest of the current iteration of a for, while or do…while loop
  - Do not stop the current loop



Language – Arduino Functions

- Arduino Nano Pin types
  - Digital I/O pins: D0 - D13, A0 - A5 (Green)
  - Analog input pins: A0 – A7 (Orange)
  - Power pins: 3.3V, 5V, GND (Red)
  - Other pins: RST, REF (Purple)
- Digital I/O:
  - `pinMode()`
  - `digitalWrite()`
  - `digitalRead()`



Language – Arduino Functions

- Digital I/O:
  - **`pinMode()`** : set the direction of a digital pin

Syntax:	pinMode(pin, mode);
Function:	Define the direction of a pin.
Arguments:	pin: the number of the pin whose mode you wish to set, in Arduino Nano , IO numbers are 0-13. mode: direction and mode, including INPUT, INPUT_PULLUP and OUTPUT.

Language – Arduino Functions

- Digital I/O:
  - **`digitalWrite()`** : set a state for a digital pin

Syntax:	`digitalWrite(pin, value);`
Function:	Write a HIGH or a LOW value to a digital pin.
Arguments:	pin: the pin number value: HIGH or LOW

Language – Arduino Functions

- Digital I/O:
  - **`digitalRead()`** : read a state from a digital pin

Syntax:	`digitalRead(pin);`
Function:	Reads the value from a specified digital pin, either HIGH or LOW.
Arguments:	pin: the number of the digital pin you want to read.
Return:	HIGH or LOW

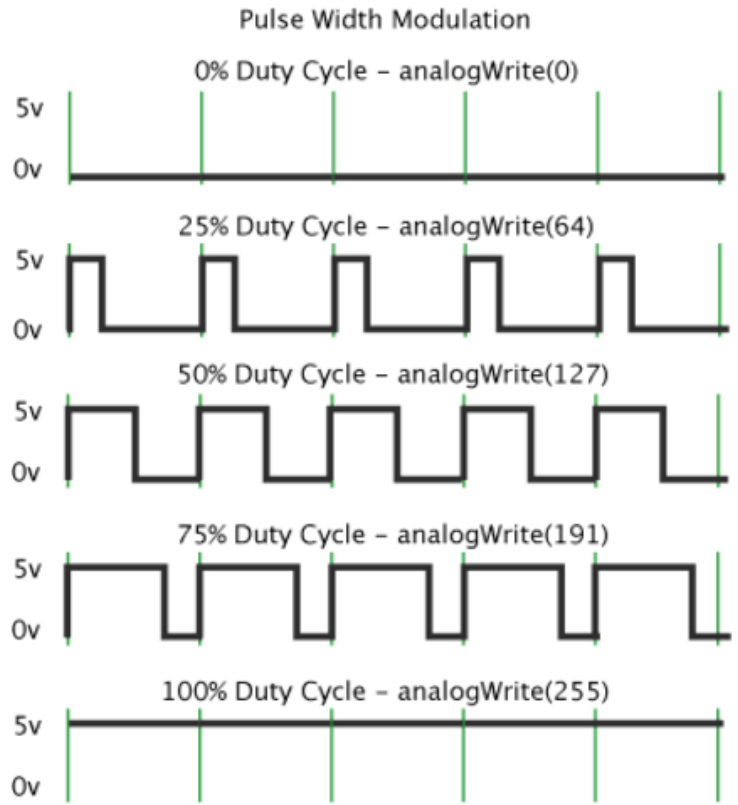
Language – Arduino Functions

- PWM Output:
  - **`analogWrite()`**: set a PWM wave with a fixed duty cycle
  - What is PWM wave? Pulse Width Modulation
    http://www.arduino.cc/en/Tutorial/PWM

Syntax:	`analogWrite(pin, value);`
Function:	Writes an analog value (PWM wave) to a pin
Arguments:	pin: 3, 5, 6, 9, 10, and 11 value: the duty cycle: between 0 (always off) and 255 (always on).

Language – Arduino Functions

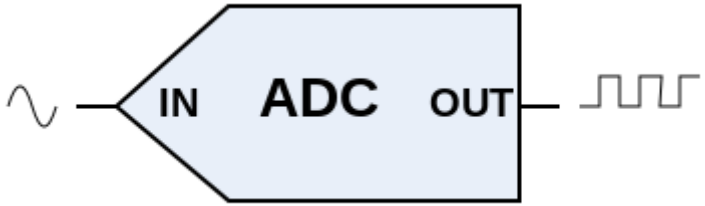
- PWM applications:
  - Motor speed control
  - LED/Lamp brightness control
  - DC-DC converter
  - DC-AC inverter
  - Communications
  - ……



Language – Arduino Functions

- Analog Input
  - analogRead(): read a analog value from a analog input pin
  - https://en.wikipedia.org/wiki/Analog-to-digital_converter

Syntax:	analogRead(pin);
Function:	read the value from analog pin
Arguments:	pin: A0-A7
Return:	ADC value (0-1023)



Language – Arduino Functions

- External Interrupts *
  - http://gammon.com.au/interrupts

Syntax:	attachInterrupt(digitalPinToInterrupt(pin), ISR, mode);
Function:	Setup the interruption
Arguments:	pin: the number of the interrupt 2 and 3 ISR: the ISR to call when the interrupt occurs; this function must take no parameters and return nothing. This function is sometimes referred to as an interrupt service routine. mode: LOW: trigger when pin is low CHANGE: trigger when pin changes value RISING: trigger when the pin goes from low to high FALLING: for when the pin goes from high to low

Language – Arduino Functions

- External Interrupts
  - It is difficult to explain what is interrupt. But input the following code and see what will happen, which is a good way to understand interrupt.

```
int pin = 13;
volatile int state = LOW;

void setup() {
    pinMode(pin, OUTPUT);
    attachInterrupt(digitalPinToInterrupt(2), blink, CHANGE);
}

void loop() {
    digitalWrite(pin, state);
}

void blink() {
    state = !state;
}
```

Language – Arduino Functions

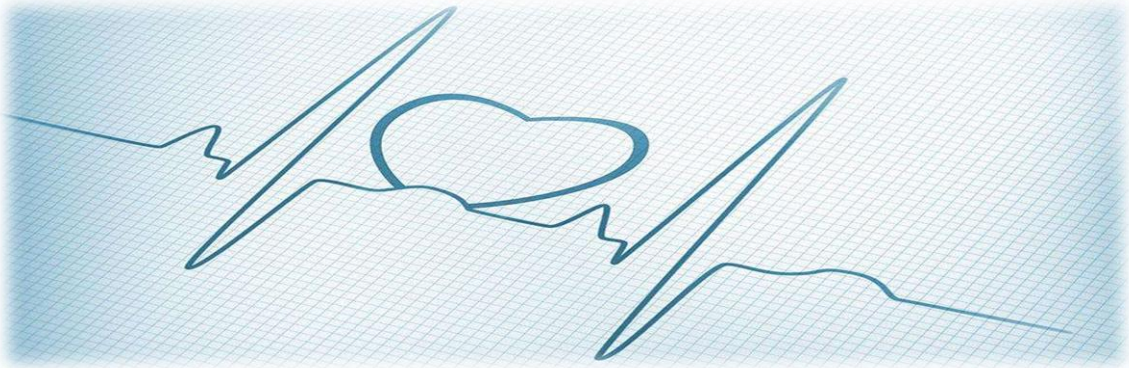
- Time control:
  - `delay(ms)`: let Arduino wait for some milliseconds
  - `delayMicroseconds(us)`: let Arduino wait for some microseconds
  - `millis()`: get the time from Arduino running in milliseconds
  - `micros()`: get the time from Arduino running in microseconds





Quiz

- Generate a square wave with a specific frequency using Arduino Nano digital PIN.
  - Finish the code;
  - Find a way to change duty cycle;
  - Test the output wave using oscilloscope;
  - Find the limitation of this method.

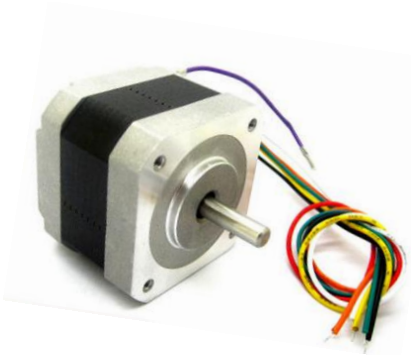


How to use them ?!

Bluetooth

LCD

Digital Tube



Motor

WiFi

. . . . . .

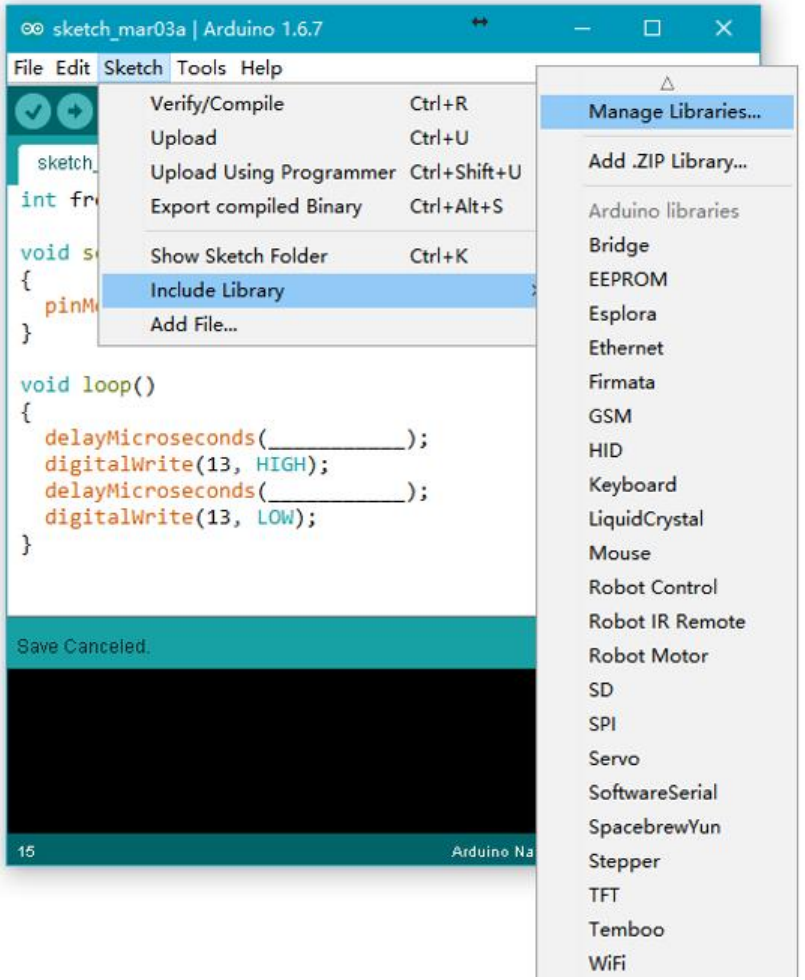
Library

Library

- When you want to use some sensors or peripherals, firstly, try to find a library for it.
- Library: someone has written the code of a device, and leave an easy interface for you to operate it.
- For most of sensors and peripherals, the library has be done!
- So just use them to start you idea!

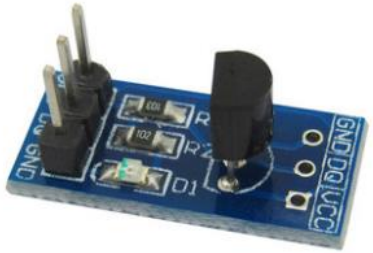
Find a library

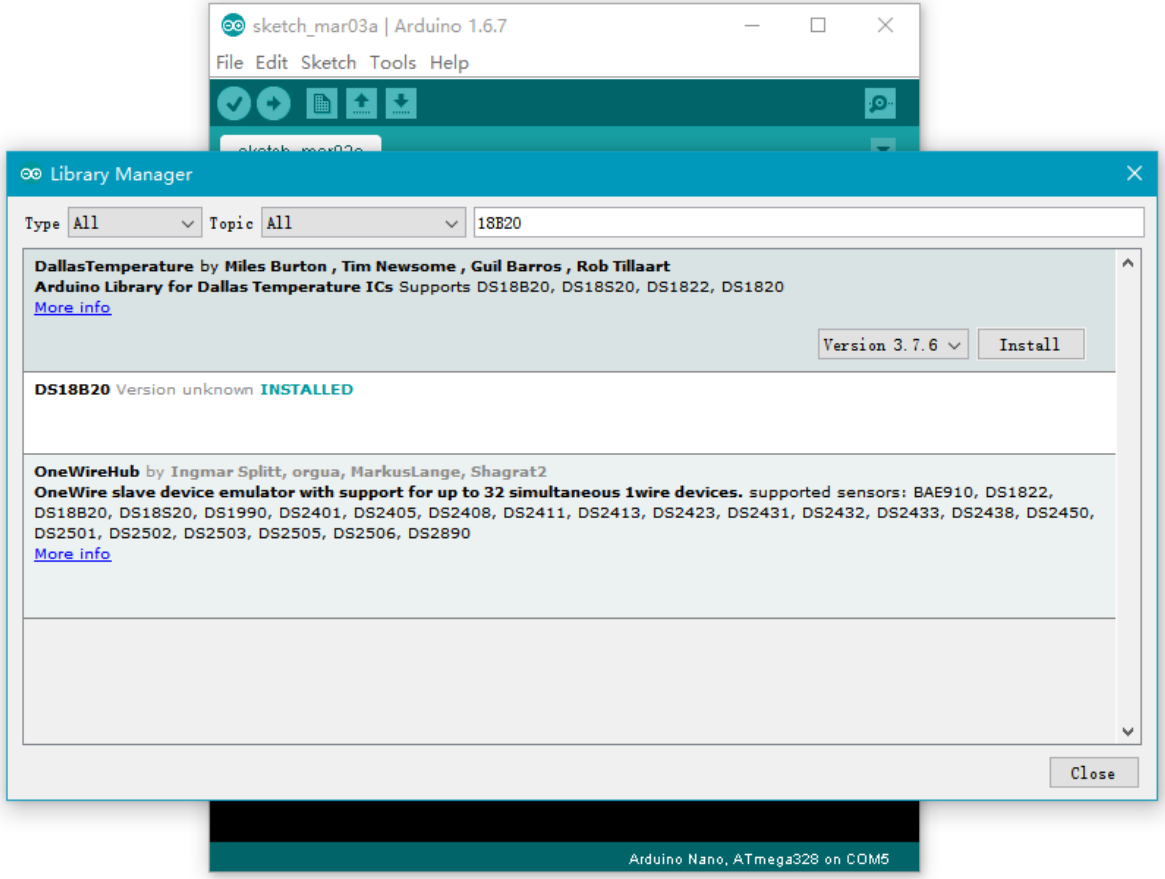
- Two ways to find a library:
  - Sketch->Include Library-> Manage Libraries
  - Sketch->Include Library-> Add .ZIP Library
    - Find zip library on Github.



Install library

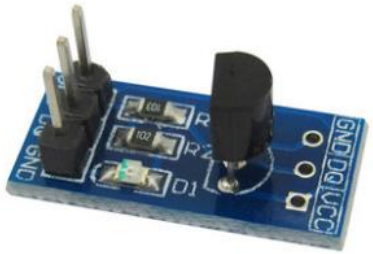
- For example:
  - 18B20 is a digital temperature sensor
  - Search this keyword and find a proper library

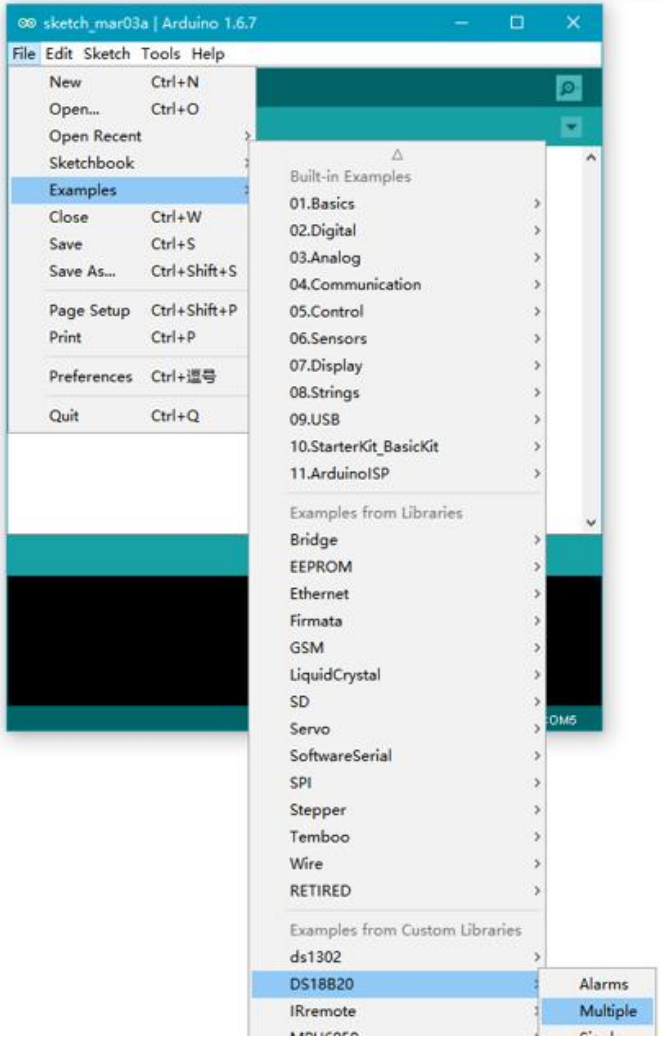




Install library

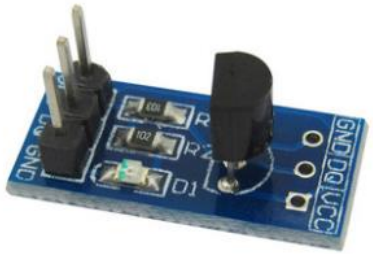
- For example:
  - 18B20 is a digital temperature sensor
  - Search this keyword and find a proper library
  - File->Example->DS18B20

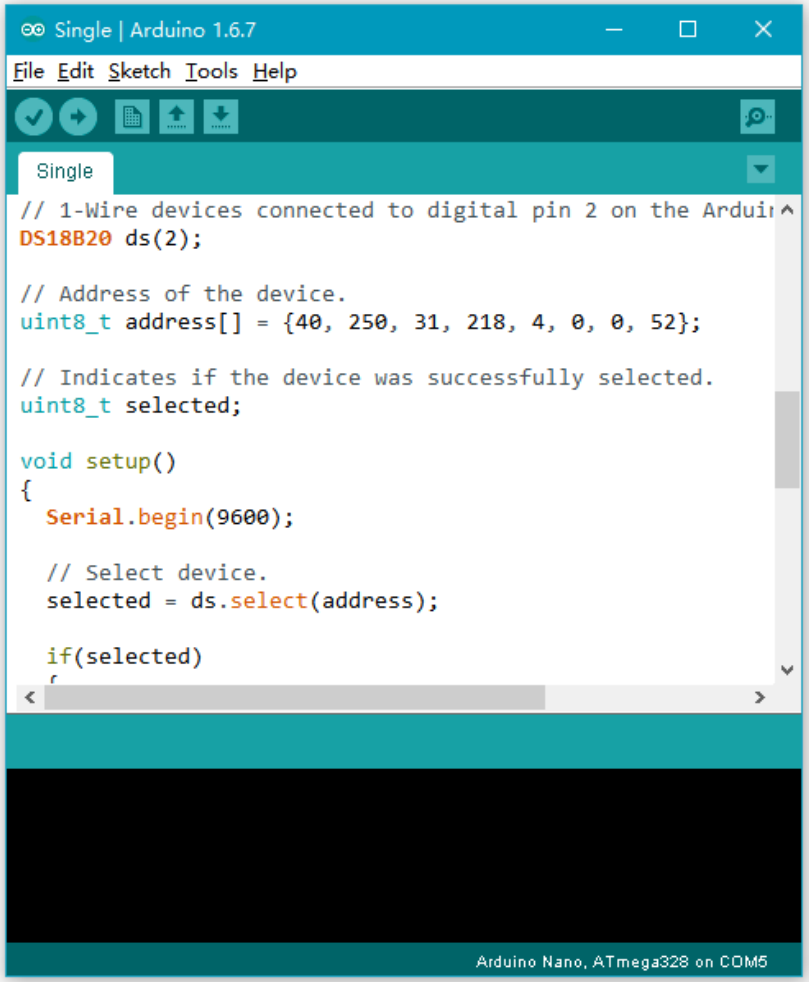




Install library

- For example:
  - 18B20 is a digital temperature sensor
  - Search this keyword and find a proper library
  - File->Example->DS18B20
  - Only need to modify few places, like pin number
  - Enjoy the sensor





We design.

We

We are connected.

we dream big.

we have "hard fun."

we try and try again.

WE ASK QUESTIONS.

We create.

are

We think deep.

We invent.

MAKERS

We collaborate.

we make mistakes.

intreesting

Reference

- www.Arduino.cc
- www.treee.com.cn