

Science Café: Programming Tiny, Colorful Computers

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Stephen Edwards "was originally thinking of making a sound board" for his Apple II, "but I've decided against doing it with hardware. I got a book about programming the Apple and I've written a sound program that's about as good as the hardware although it's not quite as controllable."

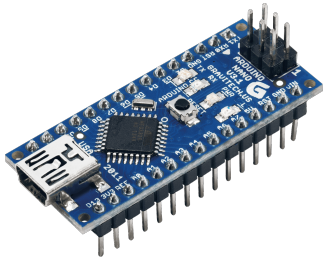


Age 11 (1981)





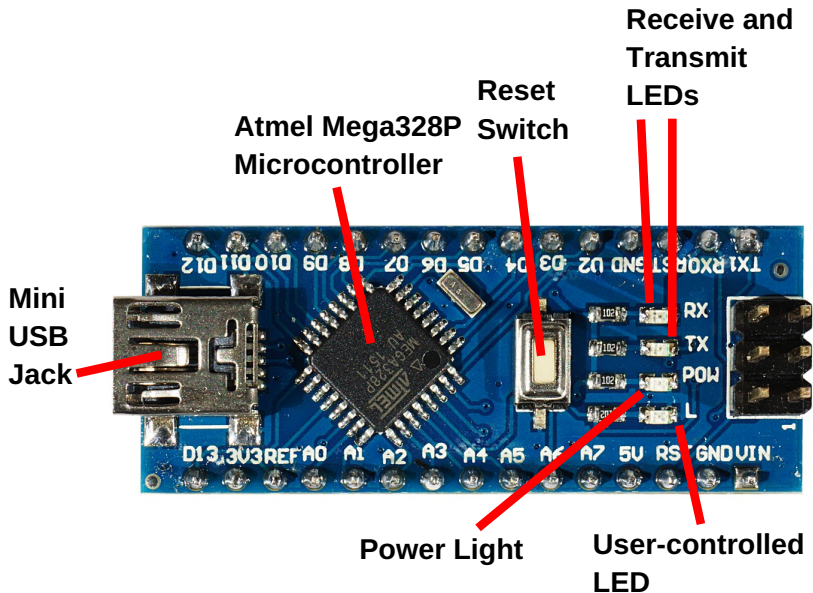




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The Arduino Nano



Getting Started

Start the Arduino IDE



Select Tools → Board → Arduino Nano

The screenshot shows the Arduino IDE interface with the **Tools** menu open. The menu items are as follows:

- Auto Format (Ctrl+T)
- Archive Sketch
- Fix Encoding & Reload
- Serial Monitor (Ctrl+Shift+M)
- Serial Plotter (Ctrl+Shift+L)
- WiFi101 Firmware Updater
- Board: "Arduino Nano" (highlighted in orange)
- Processor: "ATmega328P"
- Port
- Get Board Info
- Programmer: "AVRISP mkII"
- Burn Bootloader

The **Board: "Arduino Nano"** item is expanded, showing a list of boards:

- Boards Manager...
- Arduino AVR Boards
- Arduino Yún
- Arduino/Genuino Uno
- Arduino Duemilanove or Diecimila
- Arduino Nano (highlighted in orange, with a mouse cursor over it)
- Arduino/Genuino Mega or Mega 2560
- Arduino Mega ADK
- Arduino Leonardo

The background shows a code editor with the following code:

```
sketch_mar10a
void setup()
  // put your code here
}

void loop() {
  // put your code here
}
```

Connect Your Arduino

Plug the USB cable into your board

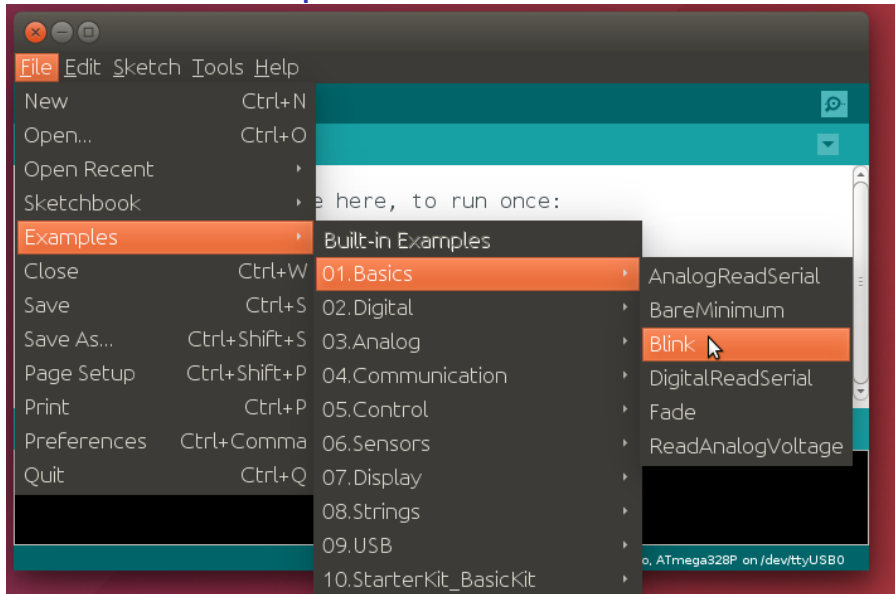
Plug your board into your computer

The board's power light should be on

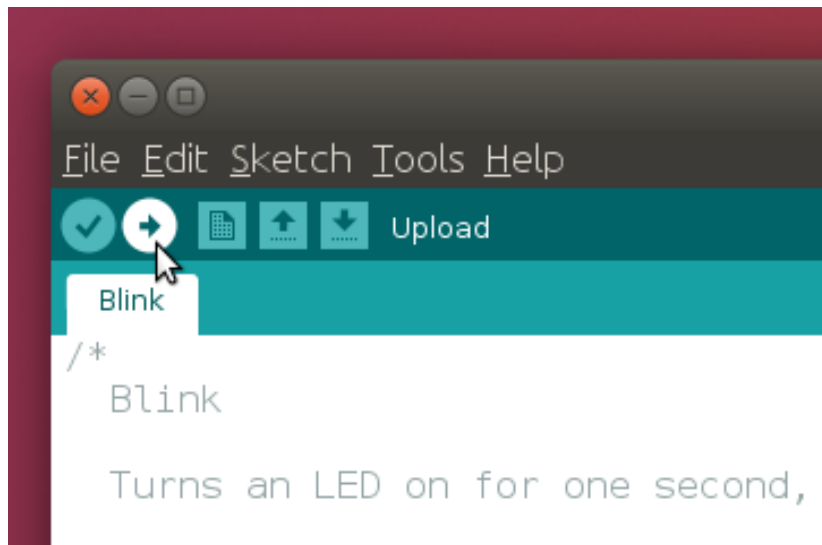
Select Tools→Port→COM3

Which COM port may vary; choose the one that is there

Select File → Examples → 01.Basics → Blink



Upload the Sketch to the Board

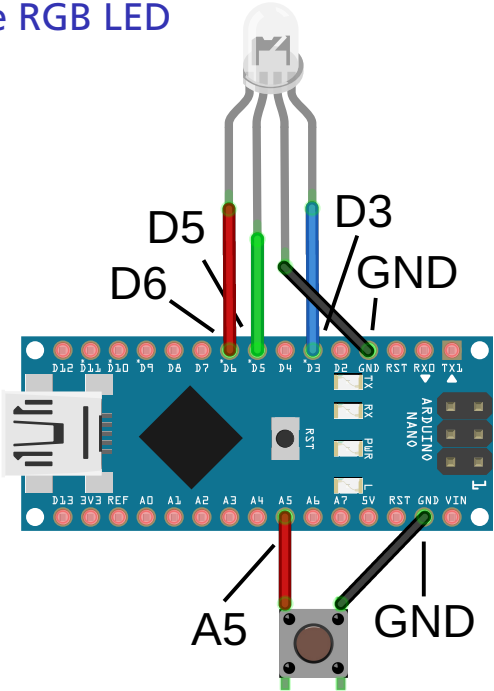


Should say "Done uploading." The user LED should blink

The Blink Example

```
void setup() {  
  pinMode(LED_BUILTIN, OUTPUT);  
}  
  
void loop() {  
  digitalWrite(LED_BUILTIN, HIGH);  
  delay(1000);  
  digitalWrite(LED_BUILTIN, LOW);  
  delay(1000);  
}
```

Connect the RGB LED and switch



Controlling the RGB LED (cycleRGB.ino)

```
const int rpin = 3, gpin = 5, bpin = 6;
```

```
void setup() {  
  pinMode(rpin, OUTPUT);  
  pinMode(gpin, OUTPUT);  
  pinMode(bpin, OUTPUT);  
}
```

```
void rgb(int r, int g, int b) {  
  analogWrite(rpin, r);  
  analogWrite(gpin, g);  
  analogWrite(bpin, b);  
}
```

```
void loop() {  
  rgb(10, 0, 0);  
  delay(500);  
  rgb(0, 10, 0);  
  delay(500);  
  rgb(0, 0, 10);  
  delay(500);  
  rgb(10, 10, 10);  
  delay(500);  
}
```

Reacting to the switch (switchRGB.ino)

```
const int rpin = 3, gpin = 5, bpin = 6;
```

```
const int spin = 19;
```

```
void setup() {  
  pinMode(rpin, OUTPUT);  
  pinMode(gpin, OUTPUT);  
  pinMode(bpin, OUTPUT);  
  pinMode(spin, INPUT_PULLUP);  
}
```

```
void rgb(int r, int g, int b) {  
  analogWrite(rpin, r);  
  analogWrite(gpin, g);  
  analogWrite(bpin, b);  
}
```

```
void wait() {  
  while (digitalRead(spin) == LOW) ;  
  while (digitalRead(spin) == HIGH) ;  
}
```

```
void loop() {  
  rgb(10, 0, 0);  
  wait();  
  rgb(0, 10, 0);  
  wait();  
  rgb(0, 0, 10);  
  wait();  
  rgb(10, 10, 10);  
  wait();  
}
```


Controlling Each Color (fadeRGB.ino)

```
const int rpin = 3, gpin = 5, bpin = 6;
```

```
const int spin = 19;
```

```
int red = 10, green = 0, blue = 0;
```

```
void setup() {
```

```
  pinMode(rpin, OUTPUT);
```

```
  pinMode(gpin, OUTPUT);
```

```
  pinMode(bpin, OUTPUT);
```

```
  pinMode(spin, INPUT_PULLUP);
```

```
}
```

```
void update(int &color ) {
```

```
  while (digitalRead( spin ) == HIGH ) ;
```

```
  while (digitalRead( spin ) == LOW ) {
```

```
    color = (color + 1) % 12;
```

```
    analogWrite(rpin, red);
```

```
    analogWrite(gpin, green);
```

```
    analogWrite(bpin, blue);
```

```
    delay(200);
```

```
  }
```

```
}
```

```
void loop() {
```

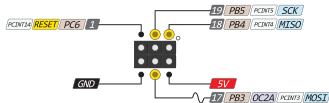
```
  update(red);
```

```
  update(green);
```

```
  update(blue);
```

```
}
```

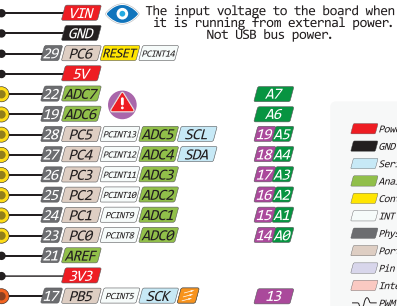
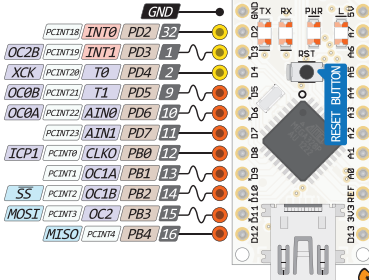
NANO PINOUT



1
0



2
3
4
5
6
7
8
9
10
11
12

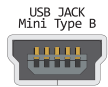


A7
A6
A5
A4
A3
A2
A1
A0
13

- Power
- GND
- Serial Pin
- Analog Pin
- Control
- INT INT
- Physical Pin
- Port Pin
- Pin function
- INTERRUPT Interrupt Pin
- ~ PWM Pin
- Port Power

! Absolute MAX per pin 40mA
recommended 20mA

⊘ Absolute MAX 200mA
for entire package



! Analog exclusively Pins

! The power sum for each pin's group should not exceed 100mA

pinMode

Each pin has a number (the pink boxes on “Nano pinout”)

Most pins can be either inputs or outputs

```
pinMode(4, OUTPUT); // Control the voltage on pin 4
pinMode(6, INPUT); // Observe the voltage on pin 6
pinMode(19, INPUT_PULLUP); // Observe 19; “suggest” it be high
pinMode(LED_BUILTIN, OUTPUT); // Control pin 13, LED ‘L’
```

Digital Input and Output

Digital: on or off, high or low voltage; nothing in between

```
digitalWrite(13, LOW); // Turn off the user LED  
digitalWrite(13, HIGH); // Turn on the user LED
```

A digital read from a pin reports either HIGH or LOW

```
if ( digitalRead(19) == LOW ) {  
    // Low voltage on pin 19, a "0"  
}  
if ( digitalRead(19) == HIGH ) {  
    // High voltage on pin 19, a "1"  
}
```