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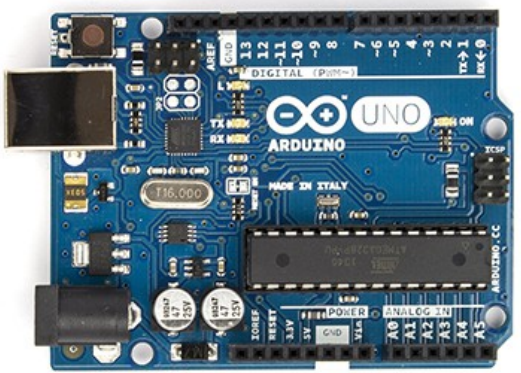
Arduino I – Einführungskurs



24. Februar 2024

Christian Walther

Agenda

Was ist ein Mikrocontroller, was ist Arduino?

Loslegen mit Software-Installation

Refresher Elektrizitätslehre

Digitale und analoge Inputs und Outputs

Kommunikation mit dem Computer

Töne erzeugen, Servo ansteuern

Ausblick

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Was ist ein Mikrocontroller?

Einsatz von programmierbaren digitalen Rechnern:

Personal Computer oder Mobilgerät

Desktop, Laptop, Spielkonsole, Tablet, Smartphone

Allzweck-Gerät
viel Rechenleistung und Speicherplatz

Mikroprozessor

Embedded-System

Digitaluhr, Kaffeemaschine, Verkehrsampel, Zahnbürste

optimiert für einen Zweck
klein und billig
alles nötige in einem Baustein

Mikrocontroller

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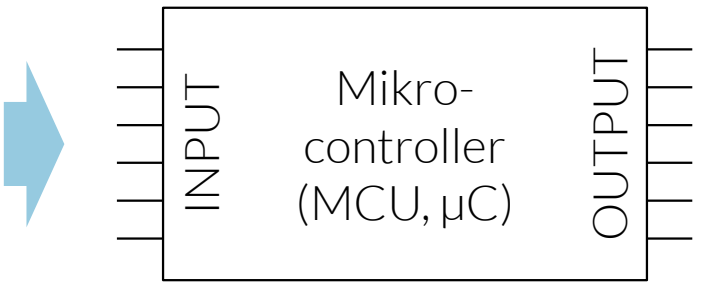
Mikrocontroller interagieren mit der Welt

Sensoren
Taste
Drehknopf
Lichtsensor
Thermometer
Mikrofon



Aktoren
Lampe
Anzeige
Motor
Heizung
Lautsprecher

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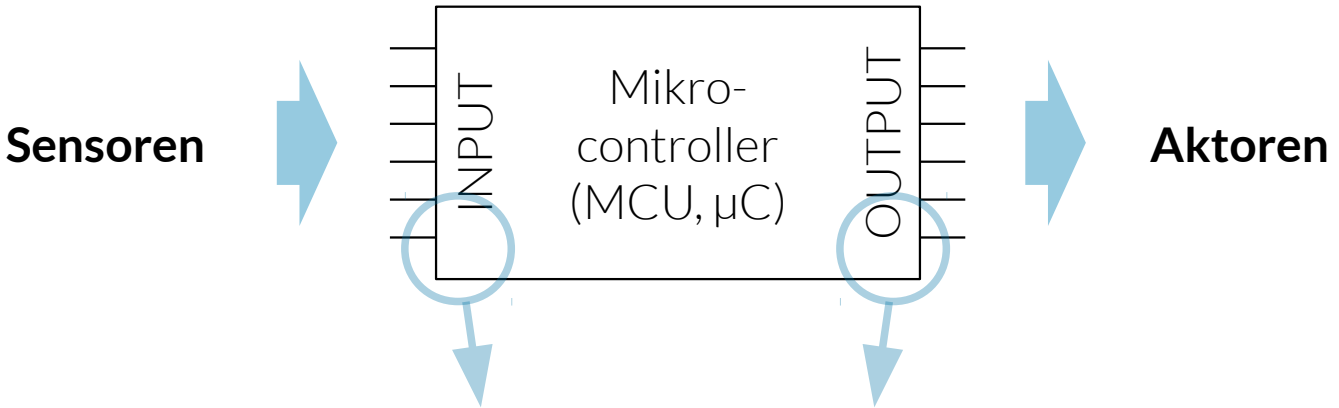
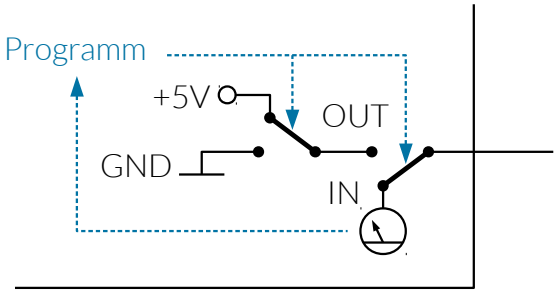
Mikrocontroller interagieren mit der Welt



GPIO Pin
General Purpose
Input/Output



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Was ist Arduino?

Ein Projekt mit dem Ziel, Bastlern, Künstlern und anderen Nicht-Ingenieuren den Einsatz von Mikrocontrollern zu ermöglichen.

Produkte (open source)

- Boards
- Entwicklungsumgebung (IDE, Integrated Development Environment)

Community

- Foren, Tutorials etc.
  - http://forum.arduino.cc
  - http://playground.arduino.cc
- Software-Erweiterungen: Libraries
- Hardware-Erweiterungen: Shields

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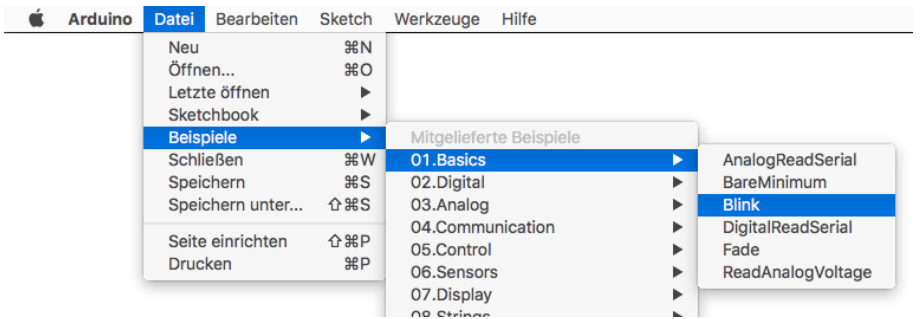
Entwicklungsumgebung (IDE) installieren

https://www.arduino.cc/en/software

Projektbuch S. 16

Sprache umschalten: File ▸ Preferences (Windows)
Arduino ▸ Preferences (Mac)

Beispielprogramm «Blink» laden



Projektbuch S. 18

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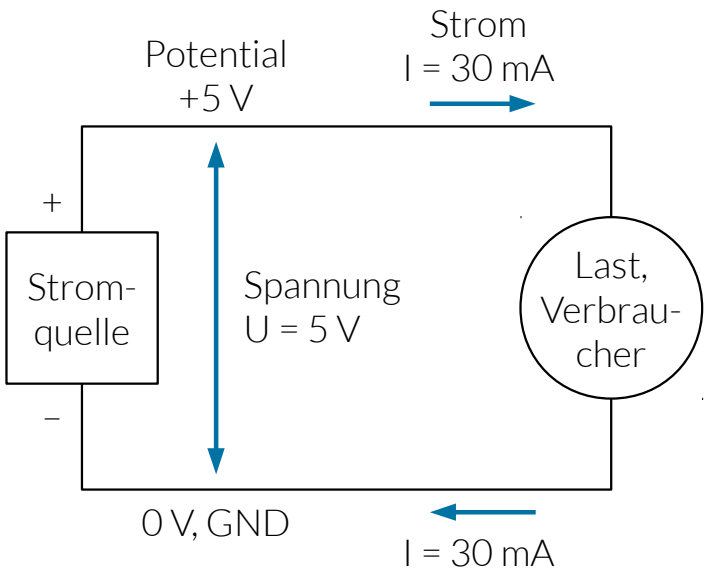
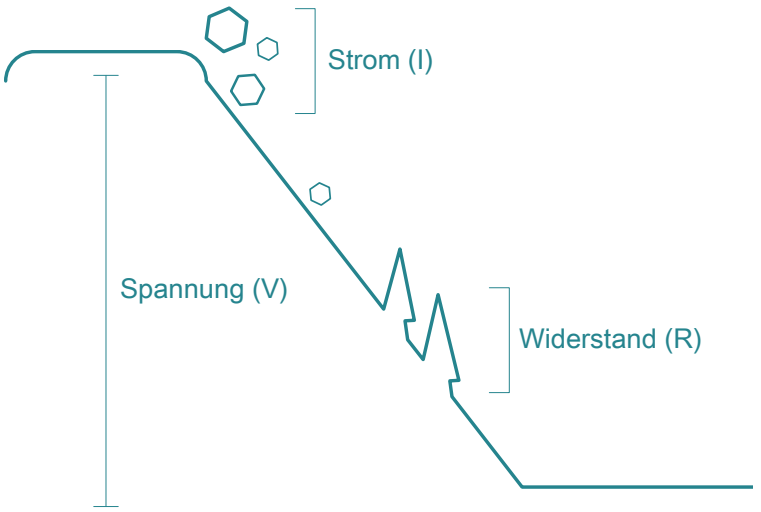
Stromkreise





Projektbuch S. 21

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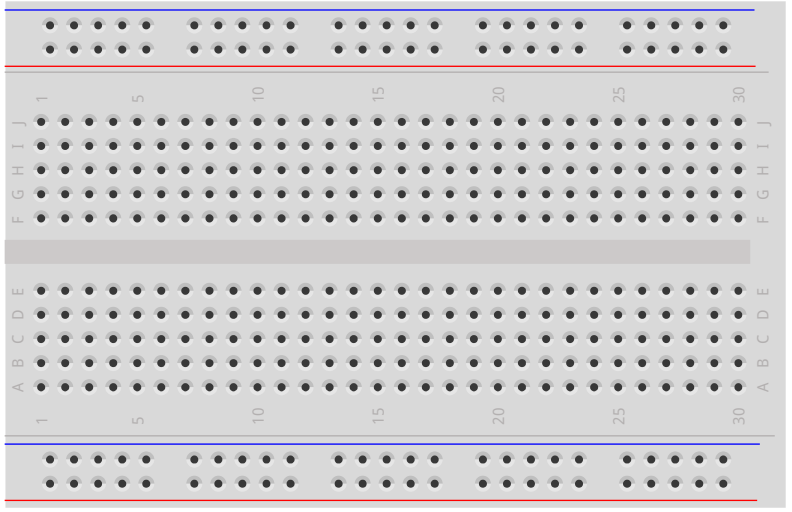
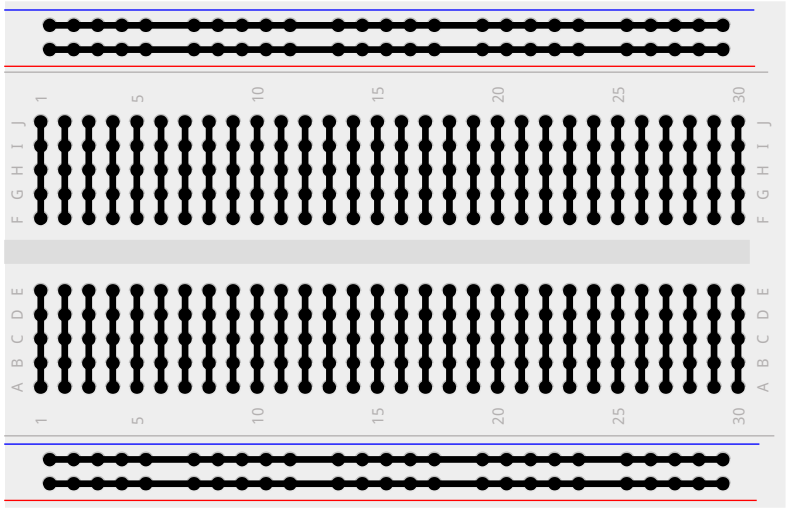
Steckbrett (Breadboard)





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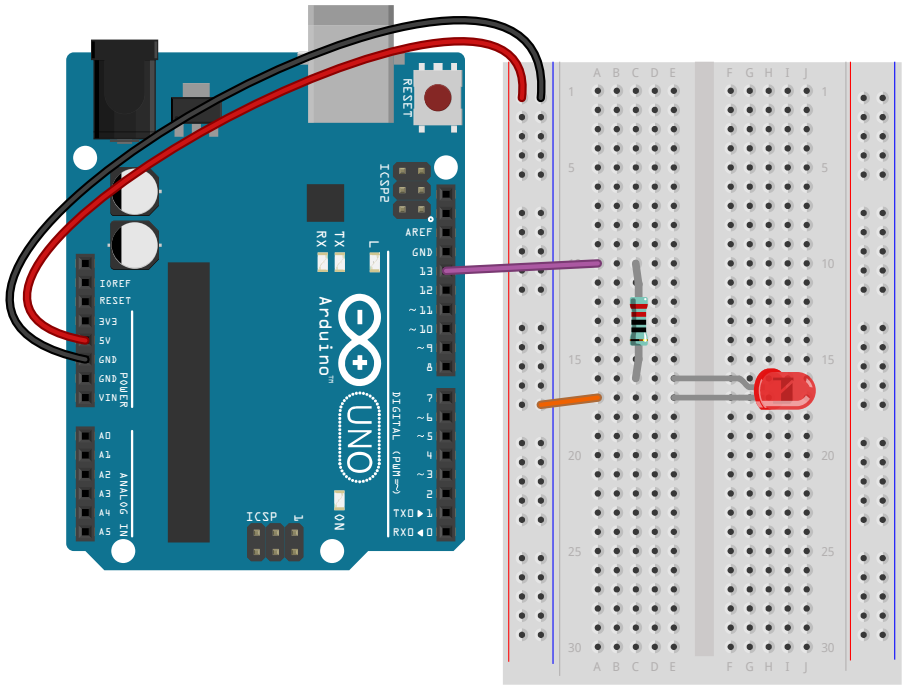
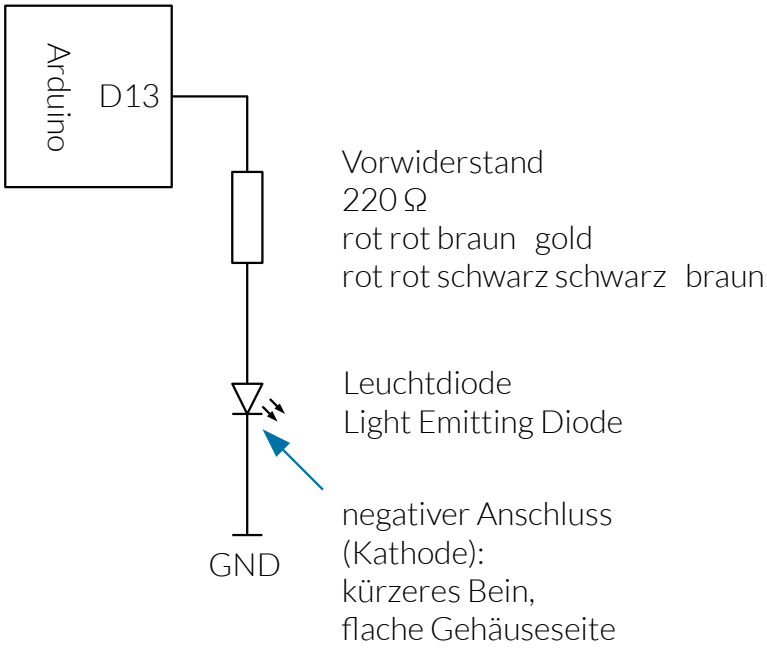
Blink mit externer LED: Digitaler Output





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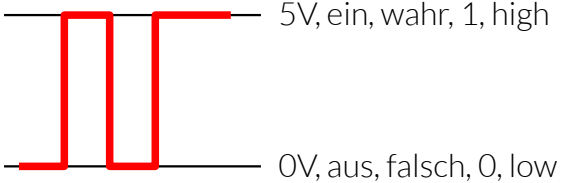
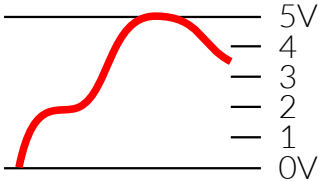
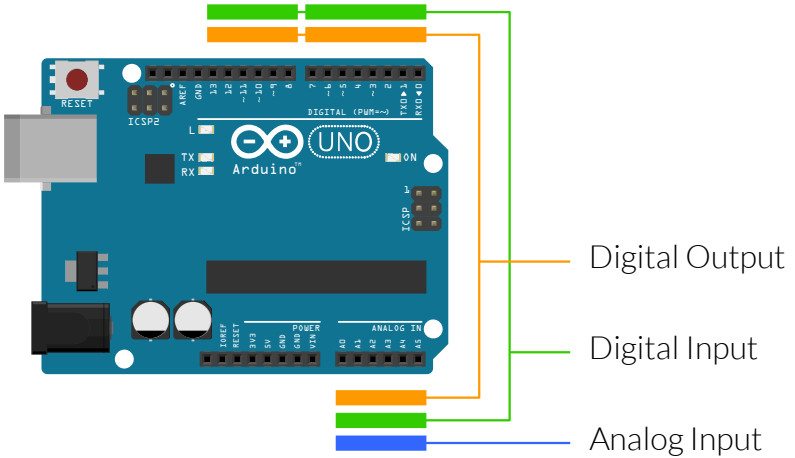
Digital und Analog

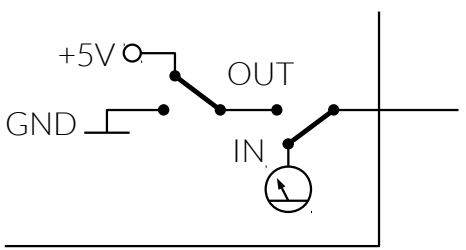
Digitales Signal



Analoges Signal







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Programmstruktur

Funktion

Kommentar

Funktions-
aufruf

```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                       // wait for a second
}
```

{} fasst Befehle zu Block zusammen

; schliesst Befehl ab

Leerzeichen und Einrückung sind optional

https://www.arduino.cc/reference

Projektbuch S. 36

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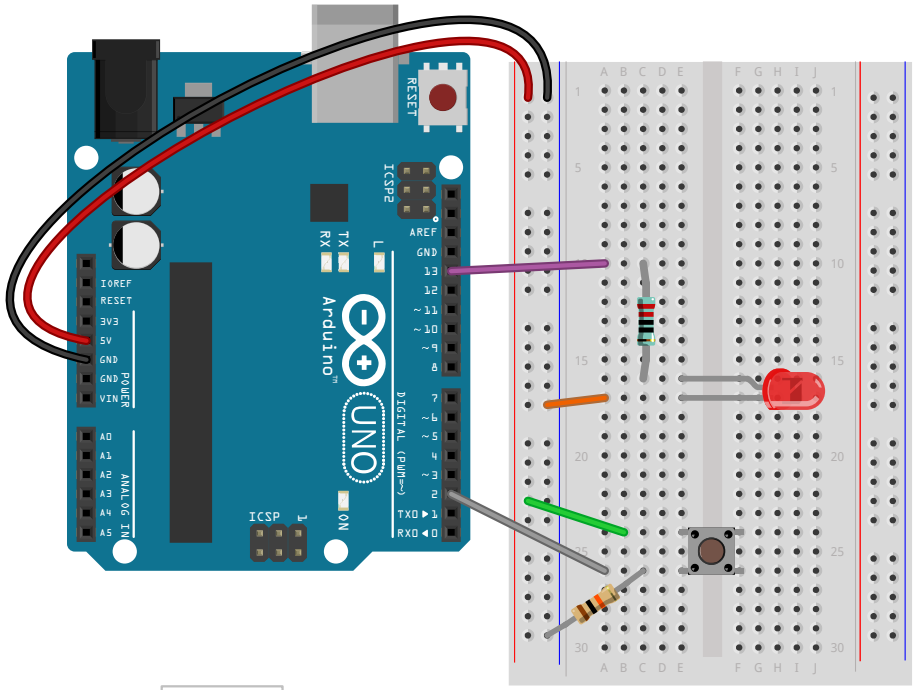
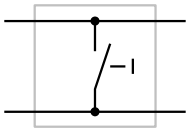
Digitaler Input





braun schwarz orange gold (10 kΩ)
braun schwarz schwarz rot braun

```
void setup() {
  pinMode(2, INPUT);
  pinMode(13, OUTPUT);
}

void loop() {
  int switchState = digitalRead(2);
  if (switchState == HIGH) {
    digitalWrite(13, HIGH);
    delay(200);
    digitalWrite(13, LOW);
    delay(200);
  }
  else {
    digitalWrite(13, LOW);
  }
}
```

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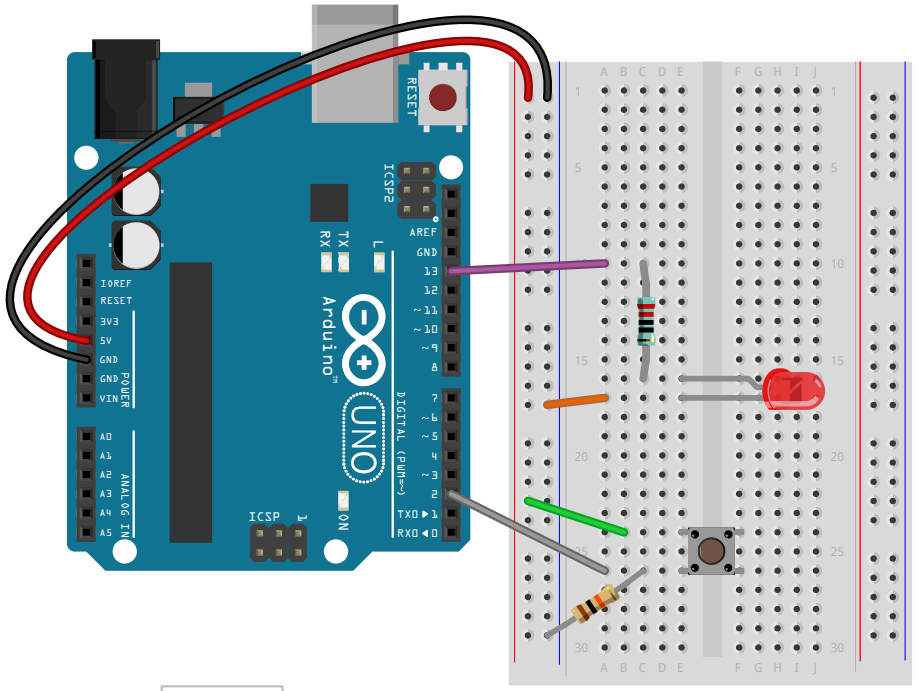
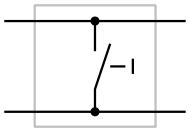
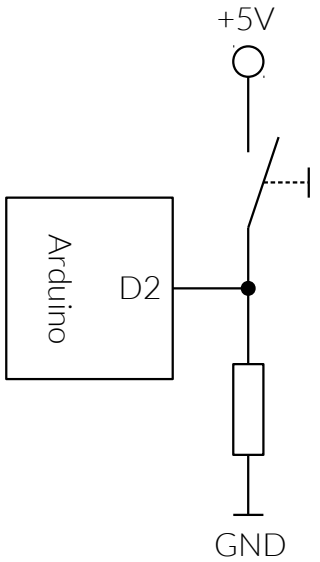
Digitaler Input







Pull-Down-
Widerstand
10 kΩ
braun schwarz orange gold
braun schwarz schwarz rot braun

Input-Pin darf nicht unverbunden sein, sonst liest er undefinierte Werte.

Projektbuch S. 35

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Digitaler Input

Variable
Datentyp: `int` = Ganzzahl
gültig innerhalb des nächstäusseren `{}`-Blocks
`=`: Zuweisung

Entscheidung
wenn/dann/sonst
`==`: Vergleich

Gross-/Kleinschreibung beachten

```
void setup() {
  pinMode(2, INPUT);
  pinMode(13, OUTPUT);
}

void loop() {
  int switchState = digitalRead(2);
  if (switchState == HIGH) {
    digitalWrite(13, HIGH);
    delay(200);
    digitalWrite(13, LOW);
    delay(200);
  }
  else {
    digitalWrite(13, LOW);
  }
}
```

Projektbuch S. 36–38

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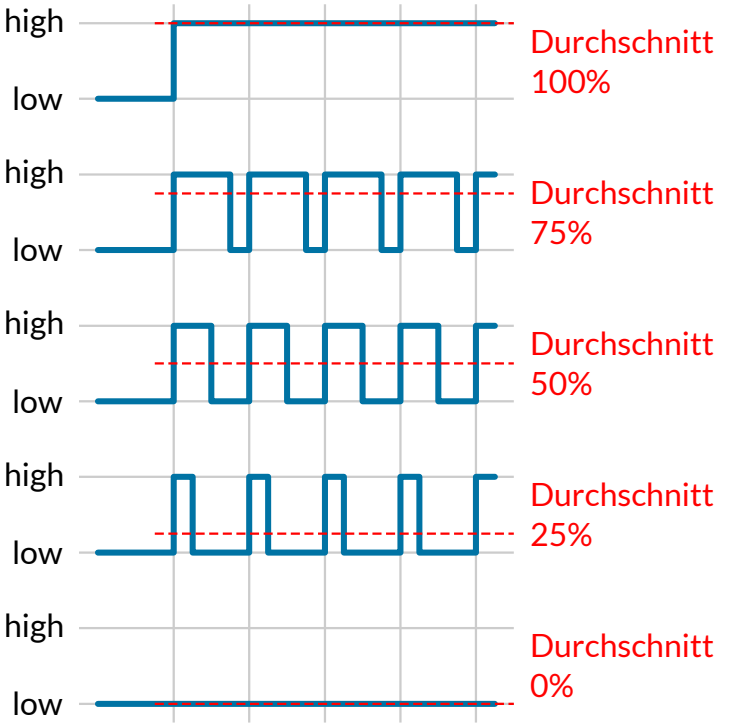
PWM-Output

Pulse-Width Modulation:
Spannung zwischen low und high simuliert durch schnelles Blinken
feste Frequenz (~490 Hz), variable Pulsbreite

vom Mikrocontroller in Hardware implementiert auf mit ~ markierten Pins

`analogWrite(`*`pin`*`, `*`duty`*`)` nimmt Wert zwischen 0 (immer aus) und 255 (immer ein), 128 = 50%

Projektbuch S. 53



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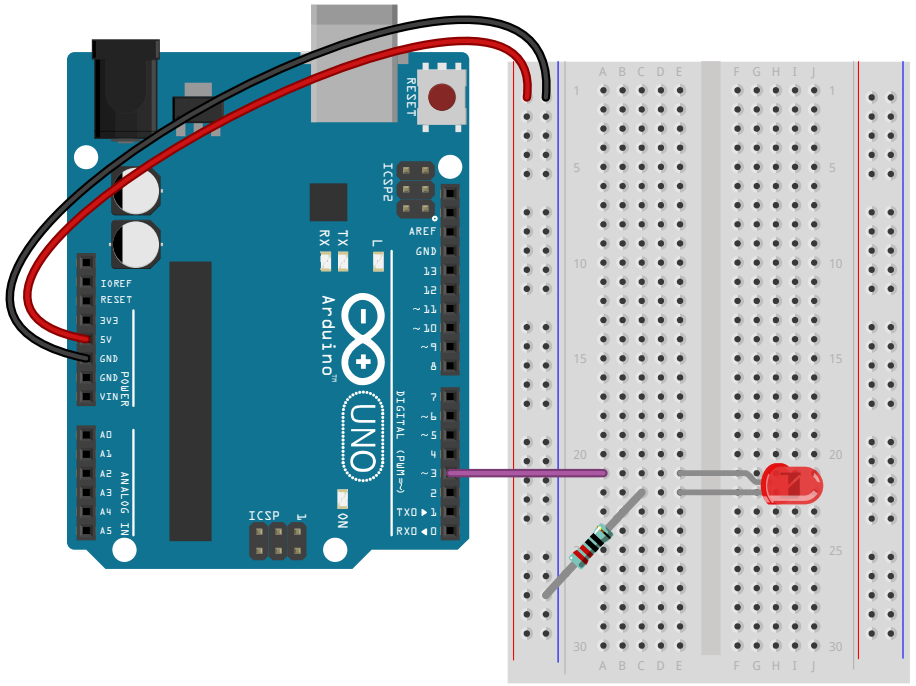
PWM-Output




```
void setup() {
  pinMode(3, OUTPUT);
}

void loop() {
  int brightness = 0;
  while (brightness < 255) {
    brightness += 51;
    analogWrite(3, brightness);
    delay(200);
  }
  while (brightness > 0) {
    brightness -= 51;
    analogWrite(3, brightness);
    delay(200);
  }
}
```

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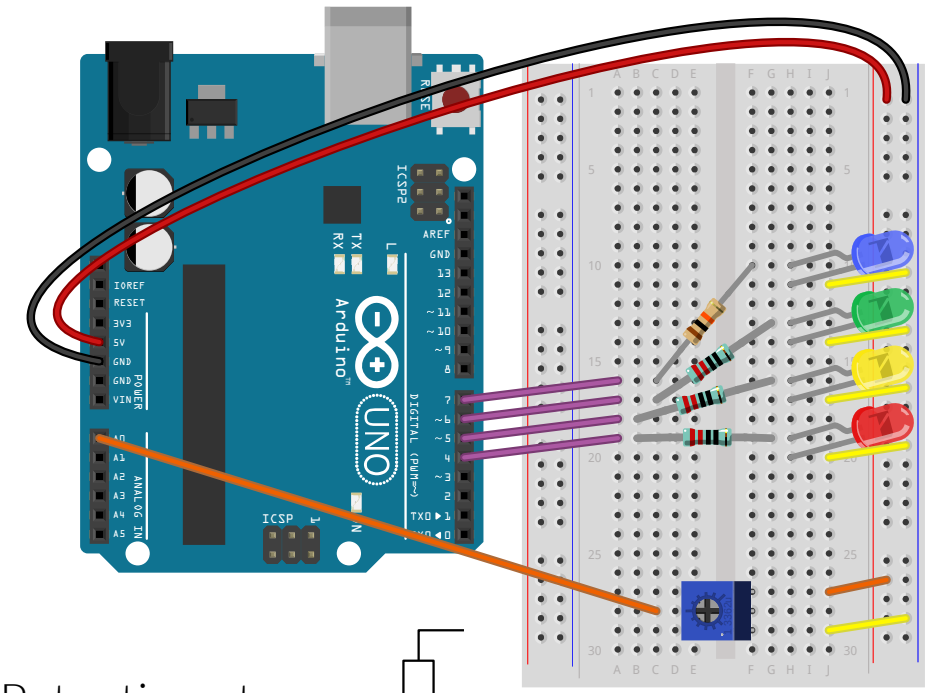
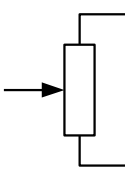
Analoger Input



Potentiometer



```
void setup() {
  pinMode(A0, INPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);
}

void loop() {
  int value = analogRead(A0);
  digitalWrite(4, value > 200);
  digitalWrite(5, value > 400);
  digitalWrite(6, value > 600);
  digitalWrite(7, value > 800);
}
```

value = 0 ... 1023
0 V 5 V

Projektbuch S. 43, 65

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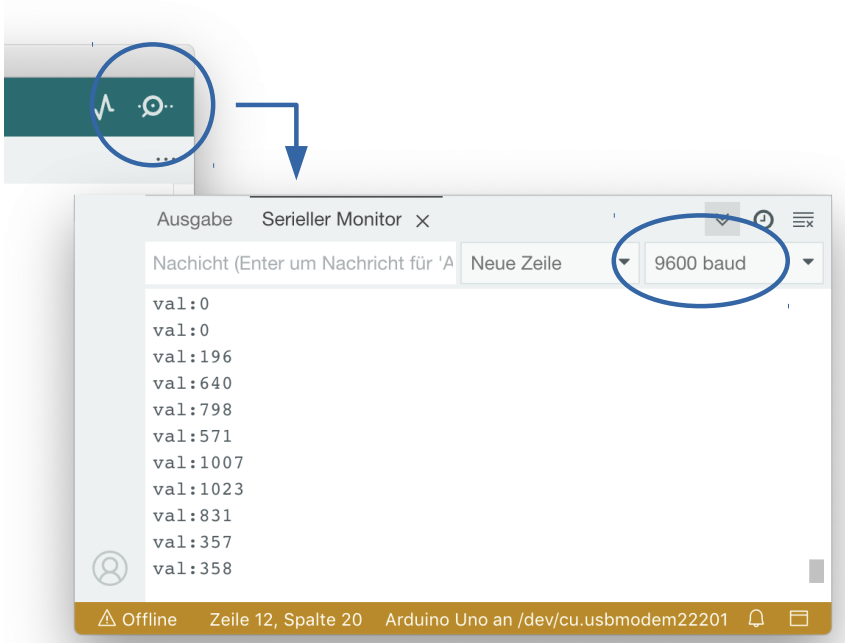
Serieller Monitor

```
void setup() {
  pinMode(A0, INPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  int value = analogRead(A0);
  Serial.print("val:");
  Serial.println(value);
  digitalWrite(4, value > 200);
  digitalWrite(5, value > 400);
  digitalWrite(6, value > 600);
  digitalWrite(7, value > 800);
  delay(200);
}
```

Projektbuch S. 43



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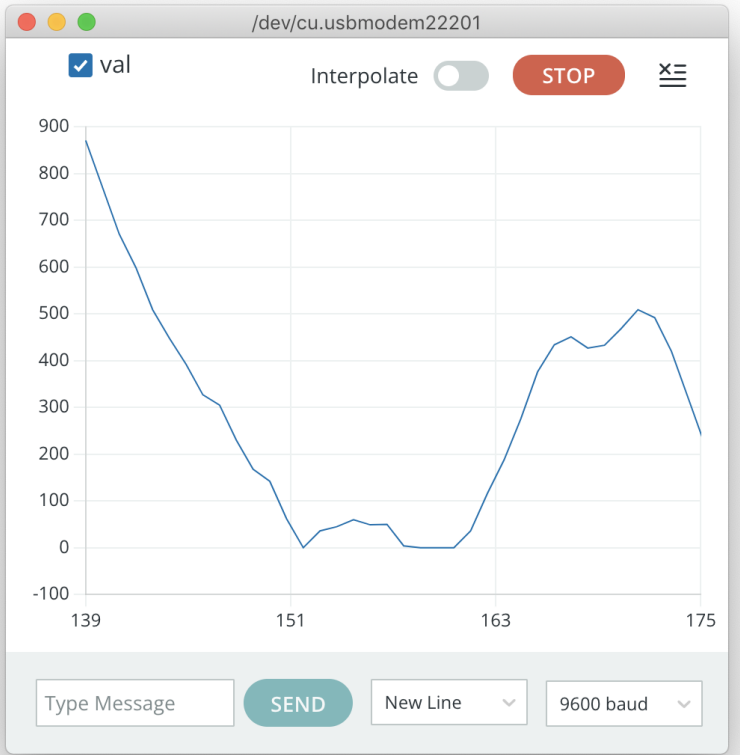
Serieller Plotter

Werkzeuge ▸ Serieller Plotter

wichtig: kein Abstand

```
Serial.print("val:");
Serial.println(value);
```



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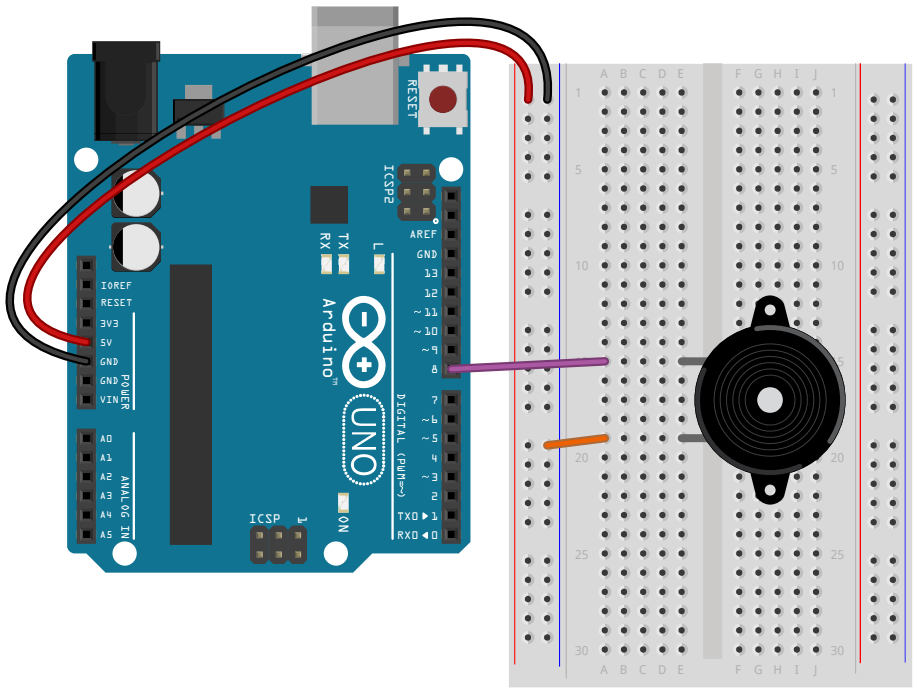
Töne erzeugen



```
void setup() {
}

void loop() {
  tone(8, 440, 200);
  delay(200);
  tone(8, 550, 100);
  delay(100);
  tone(8, 587, 100);
  delay(100);
  tone(8, 660, 100);
  delay(1600);
}
```

`tone(`*`pin`*`, `*`frequency`*`, `*`[duration]`*`)`

https://www.arduino.cc/reference/en/language/functions/advanced-io/tone/

Projektbuch S. 71, 79

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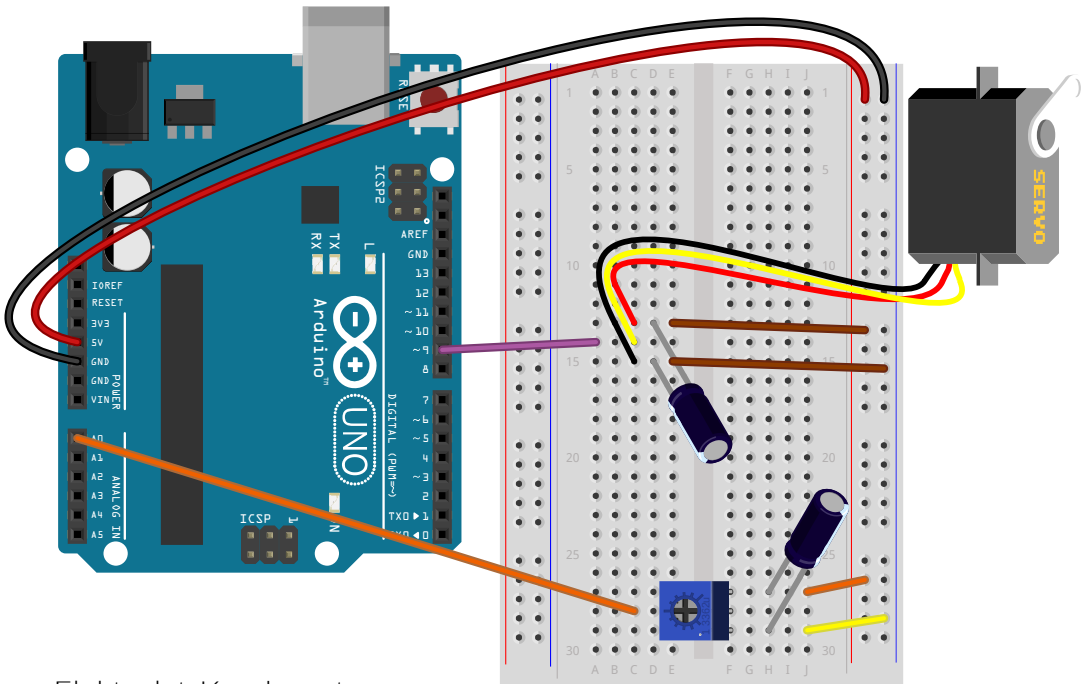
Servo ansteuern (Buch Projekt 05)



Elektrolyt-Kondensator
richtig herum anschliessen!
Minus-Markierung beachten.

Programm:

Datei ▸ Beispiele
▸ 10.StarterKit_BasicKit
▸ p05_ServoMoodIndicator

Projektbuch S. 64–67

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Ausblick

- Kontrollstrukturen: mit `if` und `while` geht alles, manchmal ist `for`, `switch`, `do while` bequemer
- Logische Verknüpfungen: Und, Oder, Nicht
- Datentypen: was sind die Limiten von `int`, was gibts sonst noch? Ganzzahlen, Kommazahlen, Zeichenketten
- Mathe: Modulo, Bitmanipulation, Zufallszahlen, Trigonometrie
- Arrays: mehrere Werte in einer Variable
- Funktionen schreiben und verwenden
- Libraries verwenden

  Im Übrigen: die Sprache ist (fast) C++, es gilt jede C- oder C++-Referenz

- Mehr Sensoren: Licht, Temperatur (analog/digital), Feuchte, Distanz, Beschleunigung, Magnetfeld
- Mehr Aktoren: Servo, DC-Motor, Schrittmotor, LCD-Anzeige, LED-Strips, Relais
- Mit anderer Hardware sprechen: Real-Time Clock, RFID, SD-Karte, GPS, Internet

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