



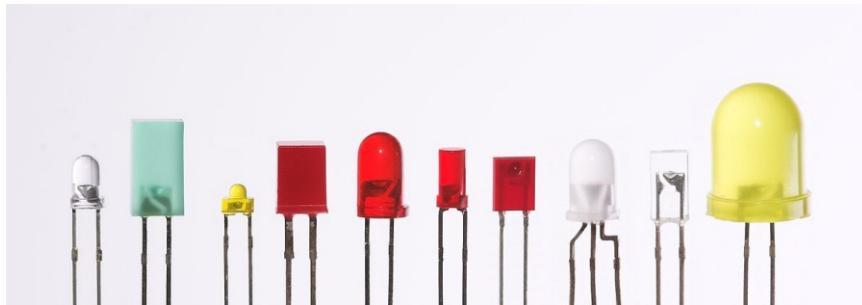
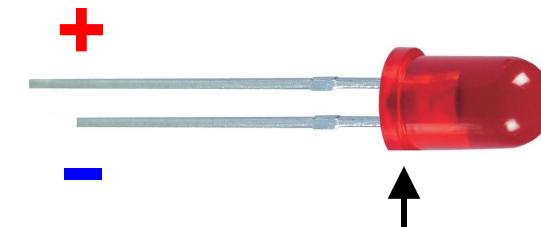
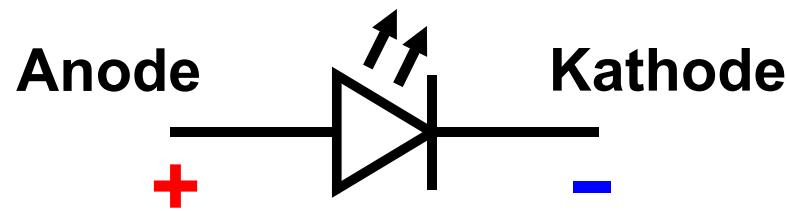
Arduino-Blinkenlights Bastelfest

Stephan Messlinger, Valentin Ochs
2017-03-17

ATTENTION

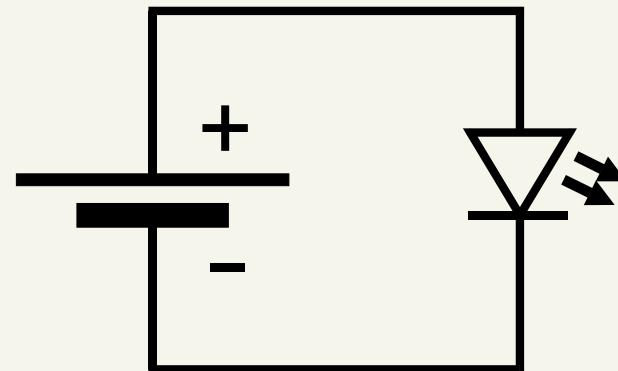
This room is fullfilled mit special electronische equippment.
Fingergrabbing and pressing the cnoeppkes from the computers is
allowed for die experts only! So all the “lefthanders” stay away
and do not disturben the brainstorming von here working
intelligencies. Otherwise you will be out thrown and kicked
anderswhere! Also: please keep still and only watchen astaunished
the blinkenlights.

Light Emitting Diodes (LED)

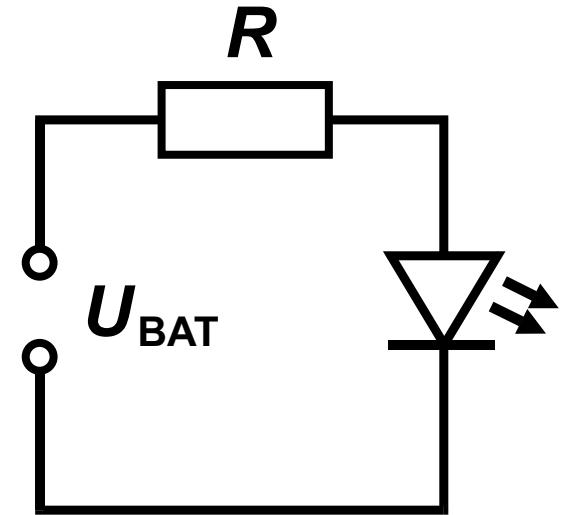
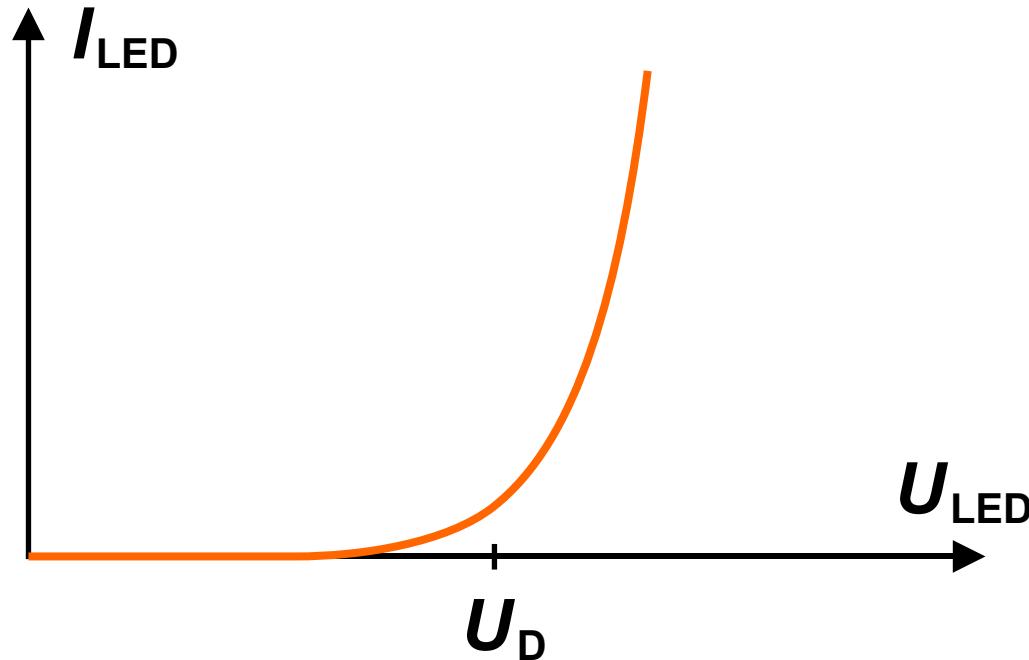


Experiment

Knopfzelle



Light Emitting Diodes (LED)



Nach Überschreiten der Durchlassspannung U_D steigt die Stromstärke exponentiell an.

→ Vorwiderstand zur Strombegrenzung nötig!

$$\begin{aligned} R &= \frac{U_{BAT} - U_{LED}}{I_{LED}} \\ &= \frac{5 \text{ V} - 2 \text{ V}}{10 \text{ mA}} \end{aligned}$$

Arduino

Microcontroller Lernplattform

Design Paradigma: Alles möglichst einfach!
Einige unintuitive Überraschungen für
Programmierer.

Viralitätsschwelle überschritten
Riesige Community, Unmengen Literatur

Erste Version entwickelt 2005 am
Interactive Design Institute, Ivrea, Italien

Arduino LLC

<http://www.arduino.cc>

Markeneintragung „Arduino“

2015-16 Rechtsstreit um Markenrechte
zwischen den Erfindern und dem italieni-
schen Hardware-Produzenten

Neuer Markenname „Genuino“ außerhalb
der USA

Software: Arduino IDE

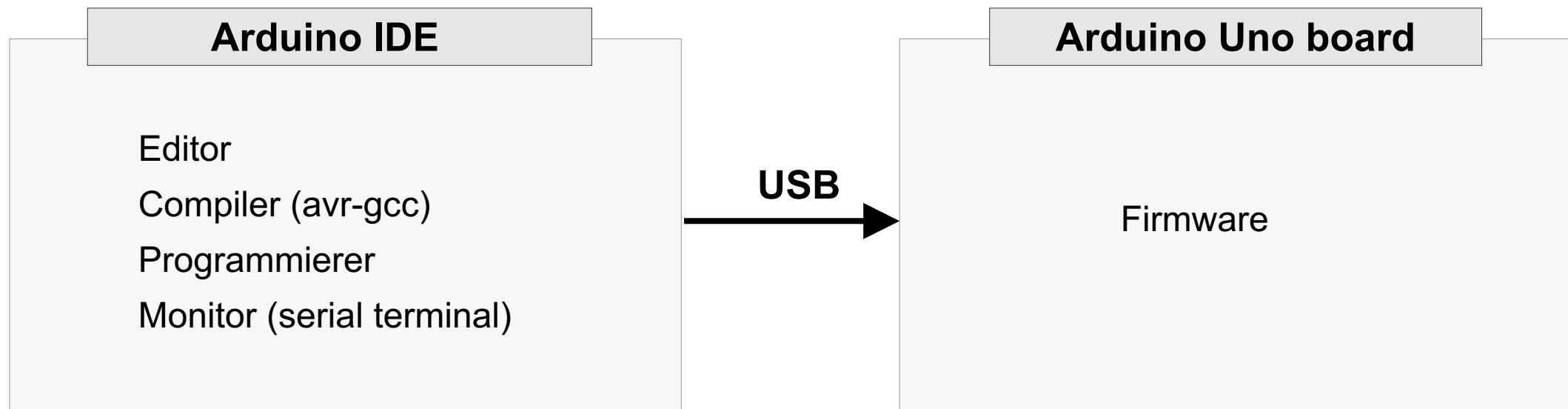
Komplette integrierte Toolchain:
Editor, Compiler, Programmierer
Cross platform
Open source (GPL 2)

Hardware

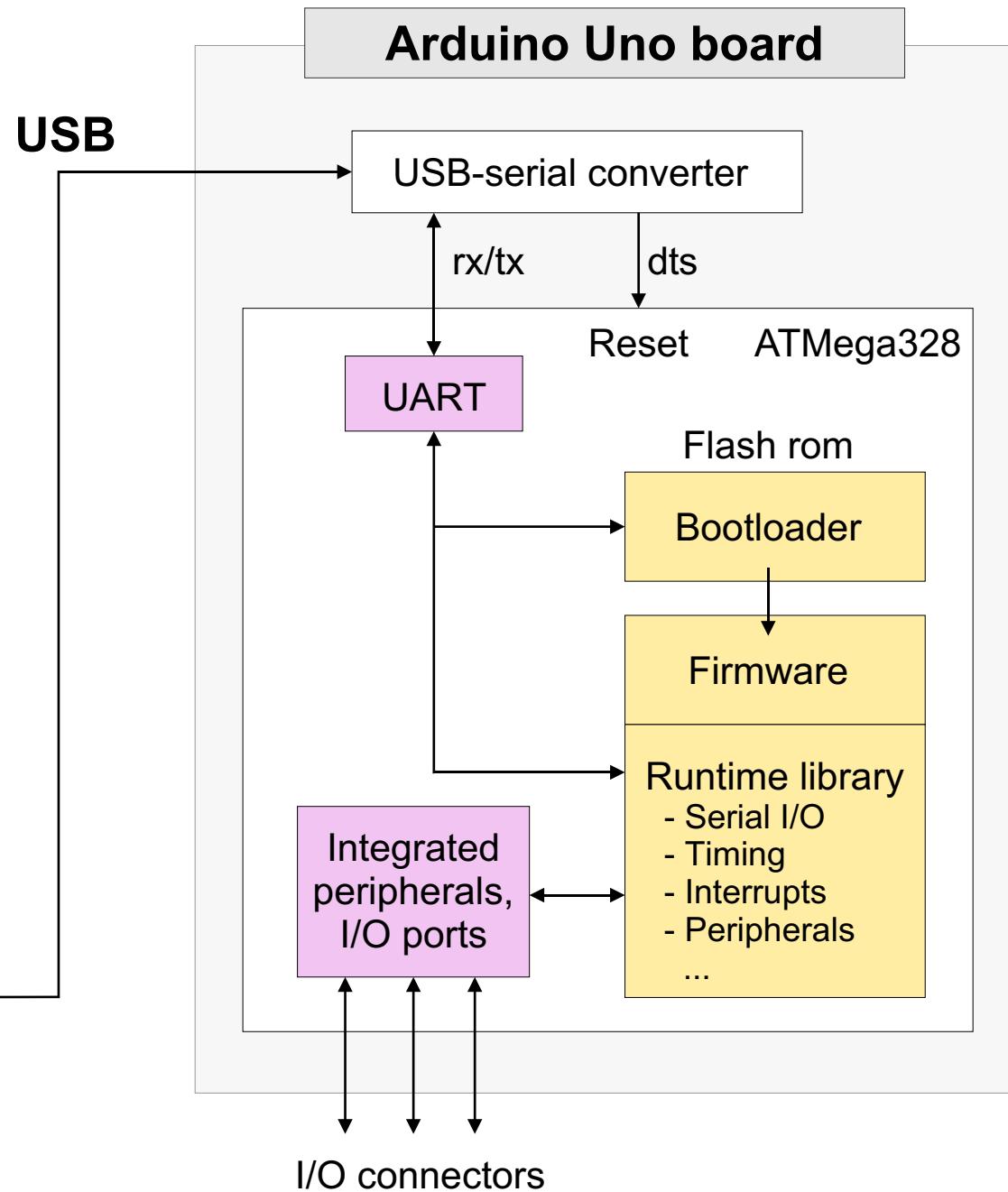
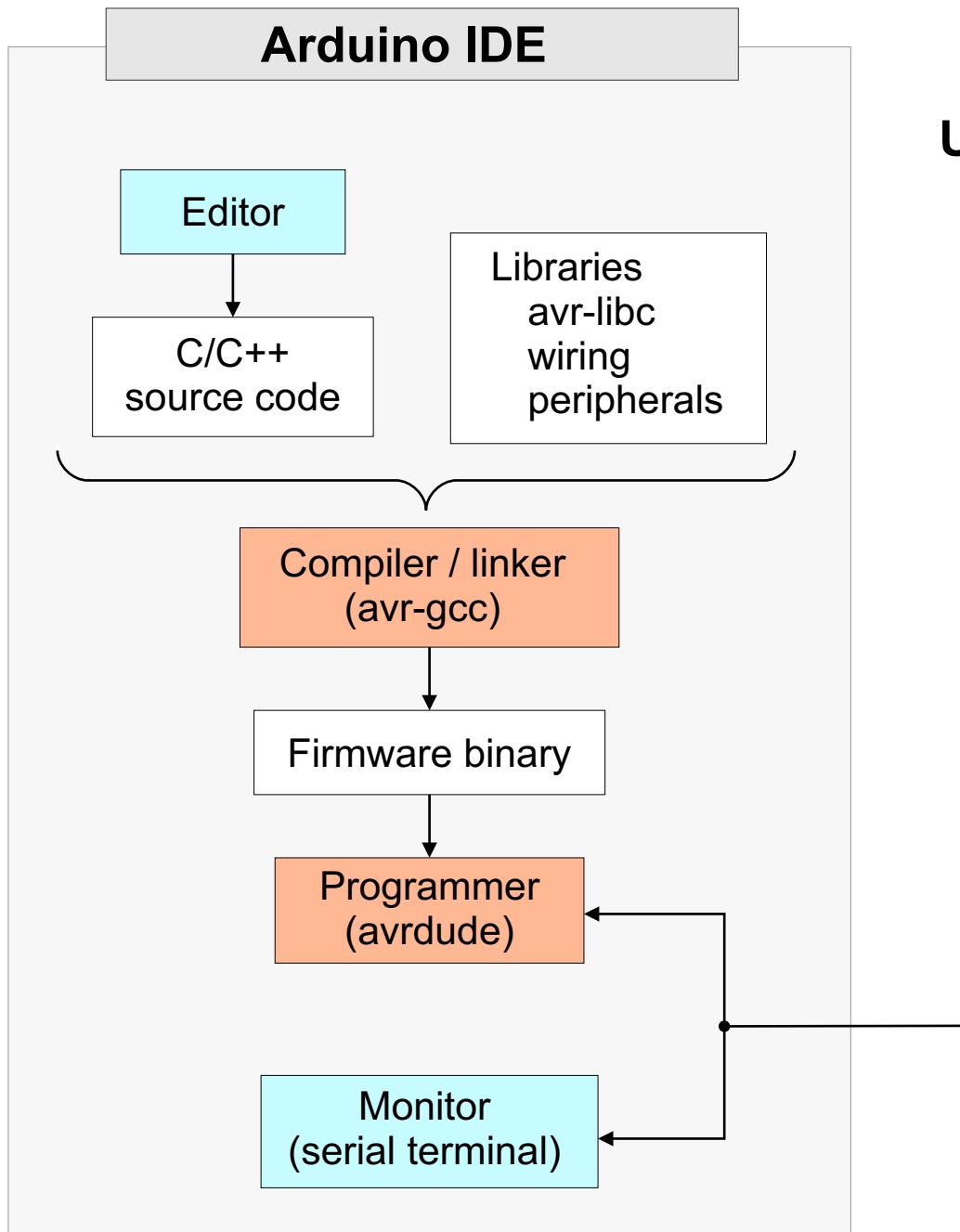
Verschiedene Entwicklungsboards:
Uno, Leonardo, Lilypad, ...
Open source (CC BY-SA 3)
Preiswert (<20 Eur)



Arduino Programmierung



Arduino Programmierung



Arduino Uno

Das "standard" Arduino board

ATMega 328 (Atmel)

32 kB flash ROM

2 kB RAM

1 kB EEPROM

16 MHz clock

18 digitale Ein-/Ausgänge, 6 PWM

6 analoge Eingänge (10 bit)

1 UART

1 SPI, 1 I2C/TWI

2 Externe Interrupts

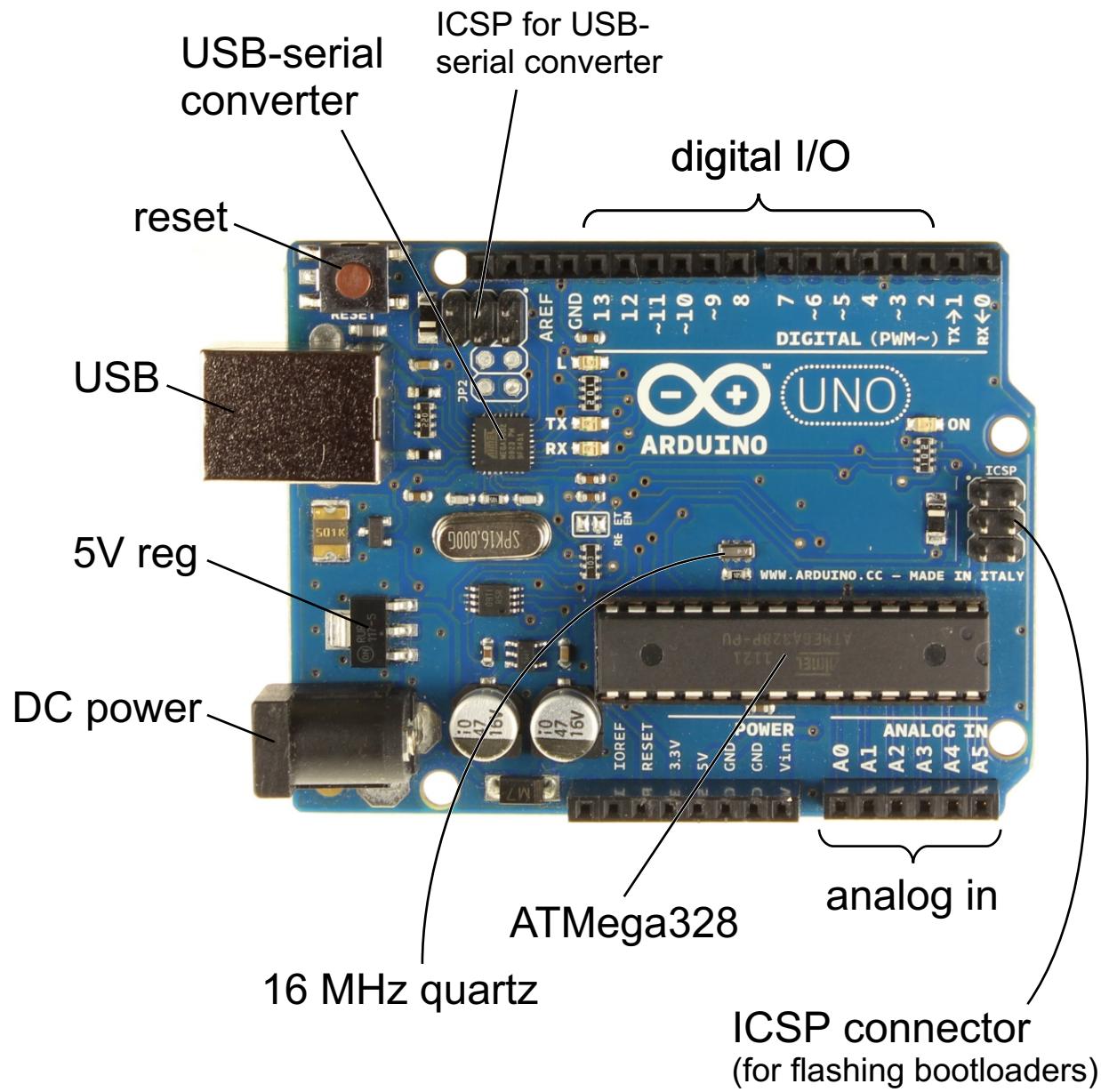
3 Counter/Timer (2x 8 bit, 1x 16 bit)

USB-Seriell-Wandler

Stromversorgung über

USB

Externes Netzteil (6-20V)



Arduino Boards

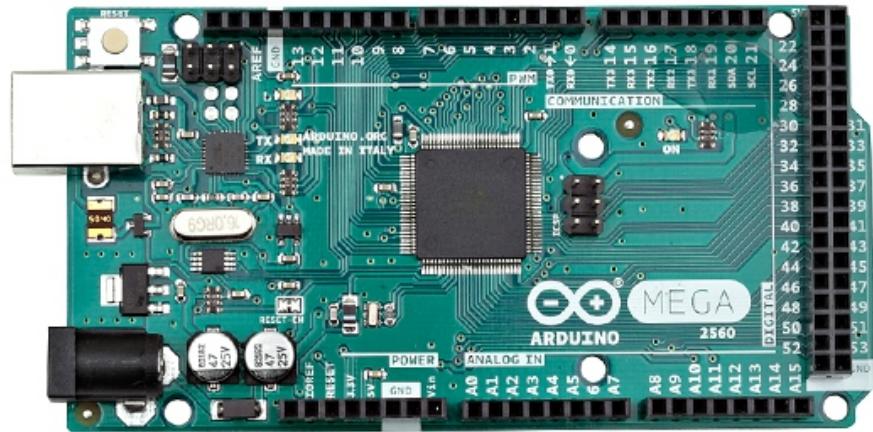
Uno



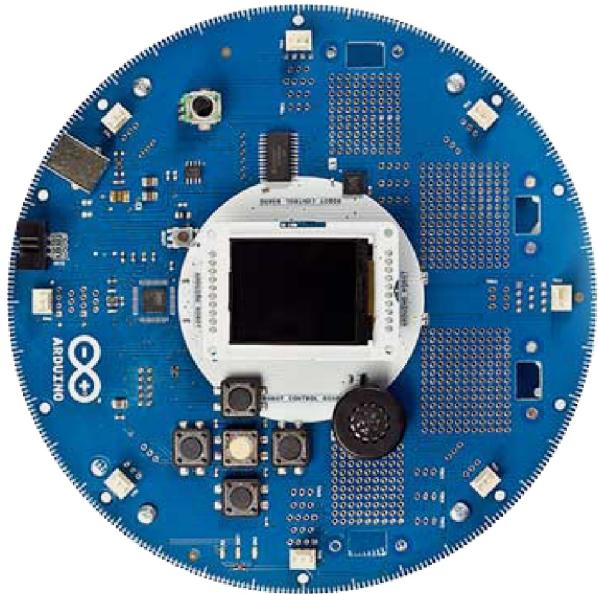
Nano



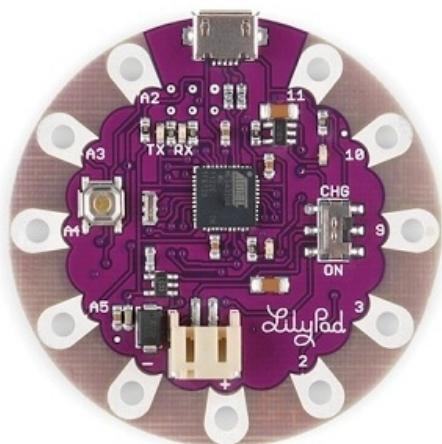
Mega



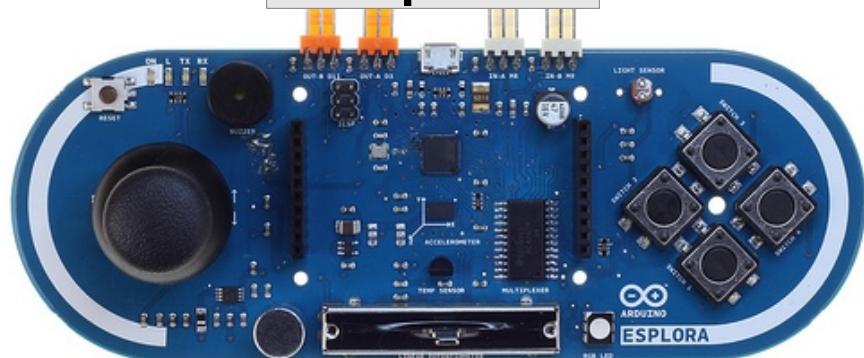
Robot



Lilypad



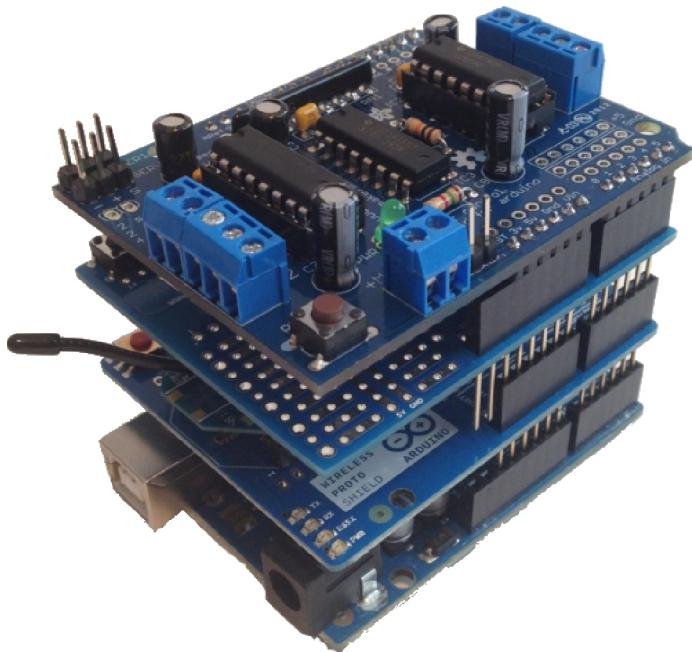
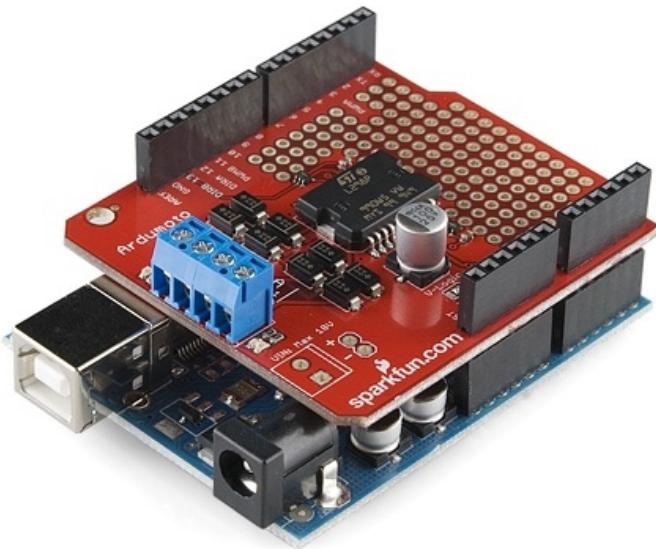
Esplora



Arduino hardware cross-reference:

<http://www.arduino.cc/en/Products/Compare>

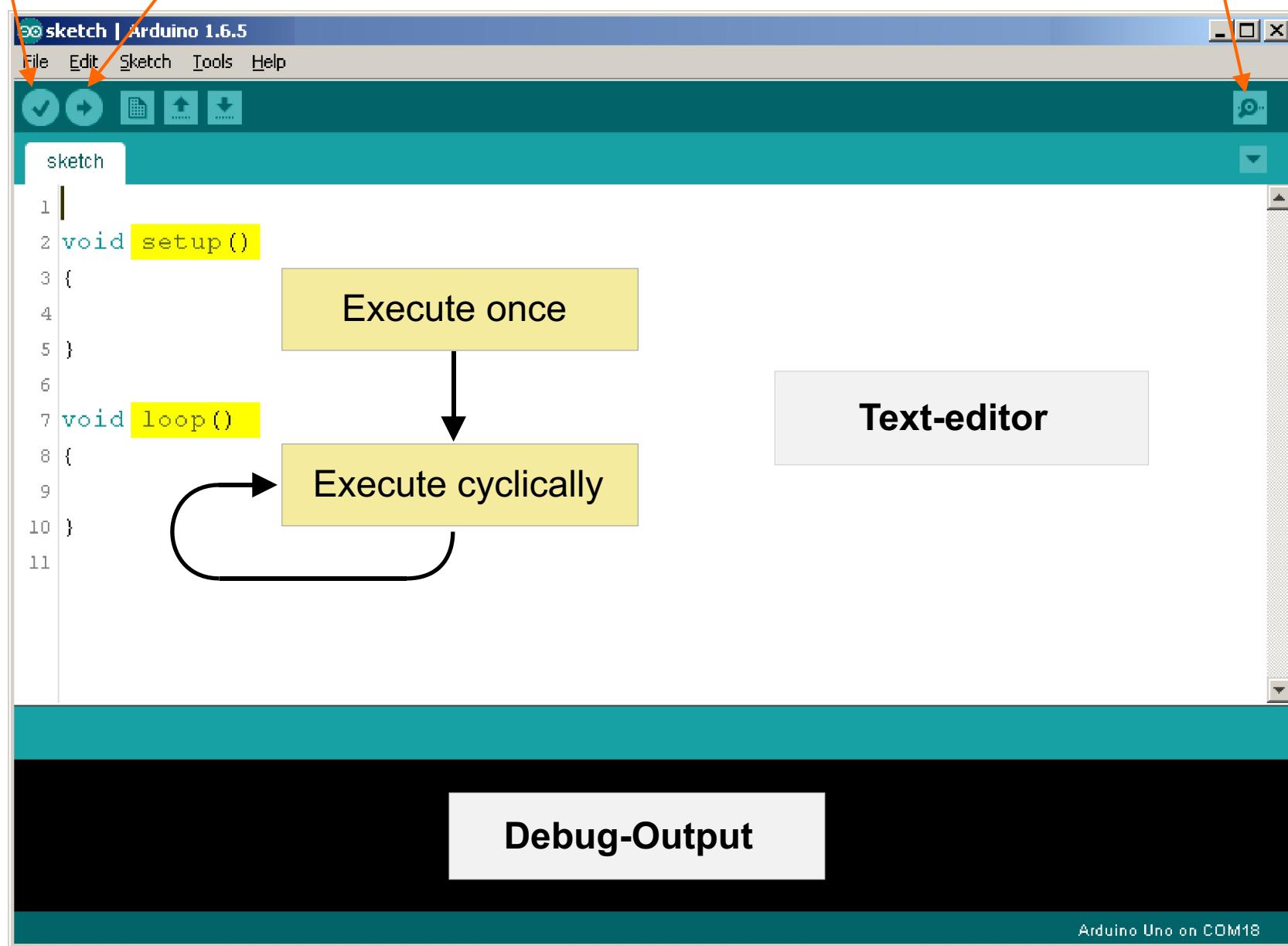
Arduino Shields



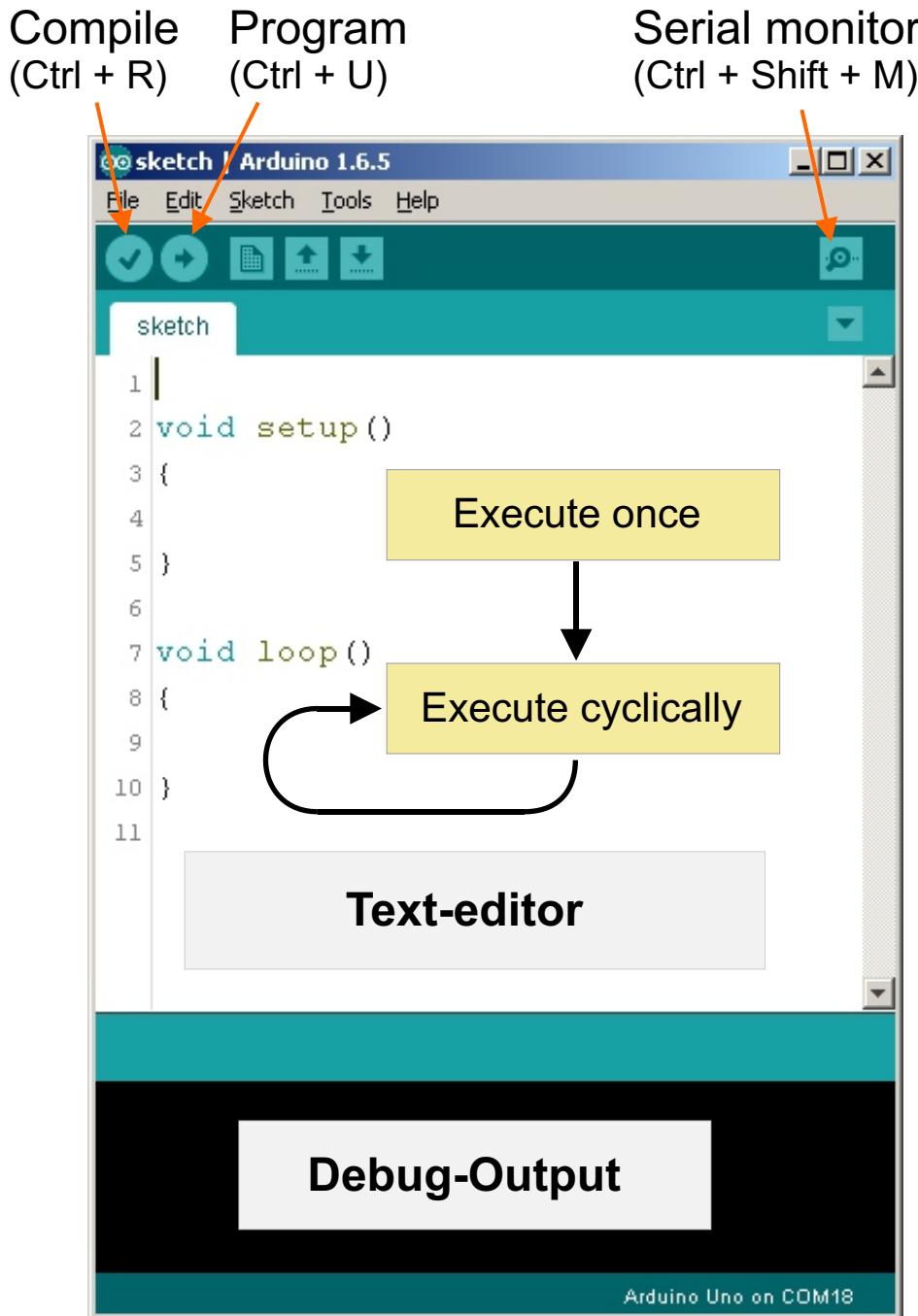
Arduino IDE

Compile Program
(Ctrl + R) (Ctrl + U)

Serial monitor
(Ctrl + Shift + M)



Arduino IDE



Compiler / linker

avr-gcc (<http://gcc.gnu.org/wiki/avr-gcc/>)

Libraries

avr-libc <http://www.nongnu.org/avr-libc/>

Arduino library (wiring)

<http://www.arduino.cc/en/Reference/..../Arduino/hardware/arduino/avr/cores/arduino>

Peripheral libraries

<http://www.arduino.cc/en/Reference/Libraries/..../Arduino/libraries>
<http://www.arduino.cc/en/Reference/Libraries/..../Arduino/hardware/arduino/avr/libraries>

Programmer

avrdude (<http://www.nongnu.org/avrdude/>)

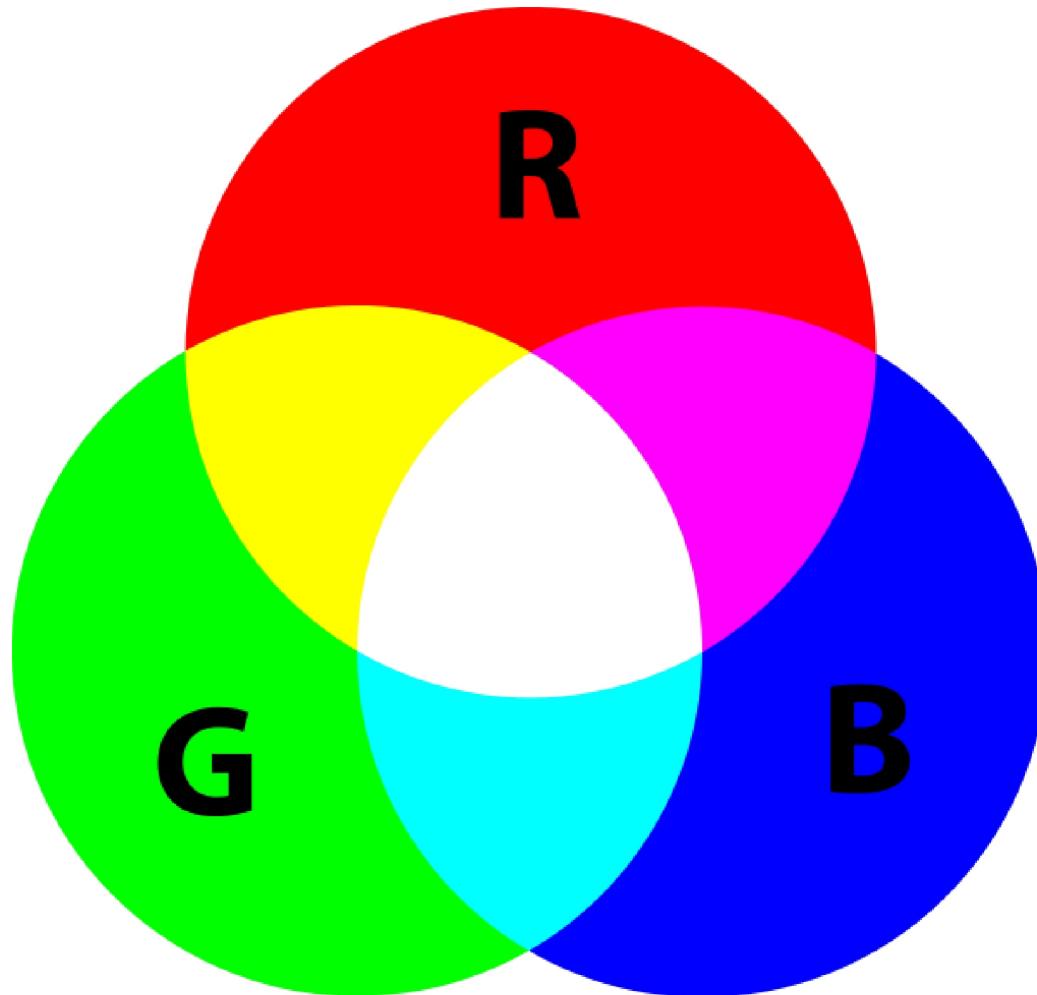
Firmware is flashed via bootloader.

No additional ISP hardware needed.

Serial monitor

Usable as I/O terminal for firmware.

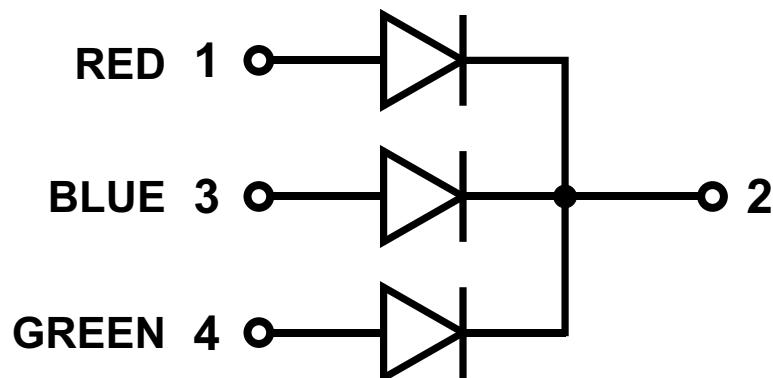
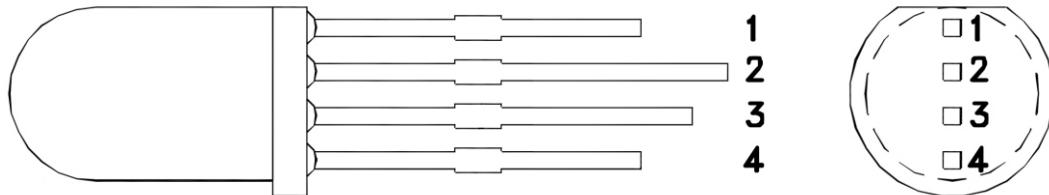
Additive Farbmischung



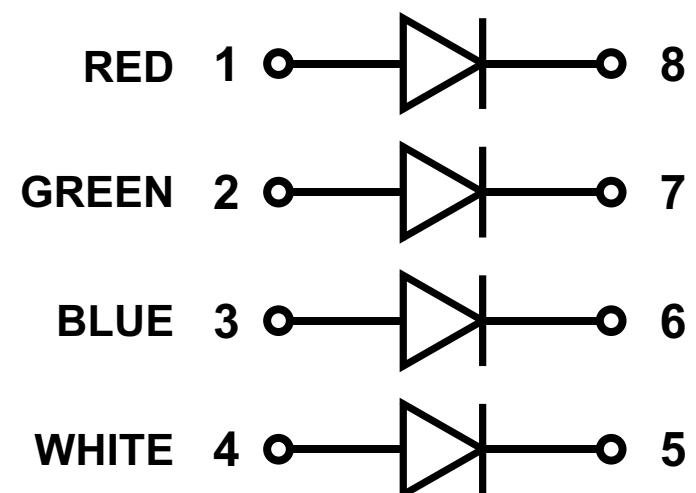
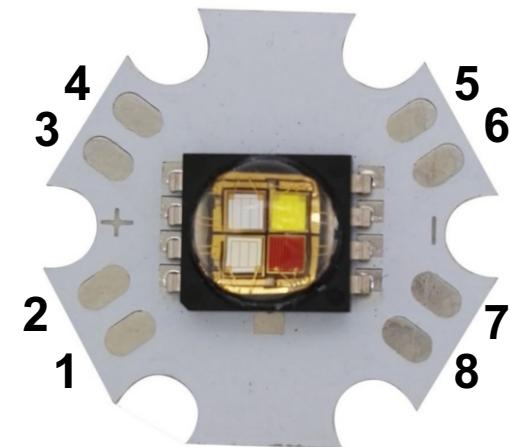
Additive Farbmischung

RGB-LED

Kingbright L-154A4SUREQBFZGEW

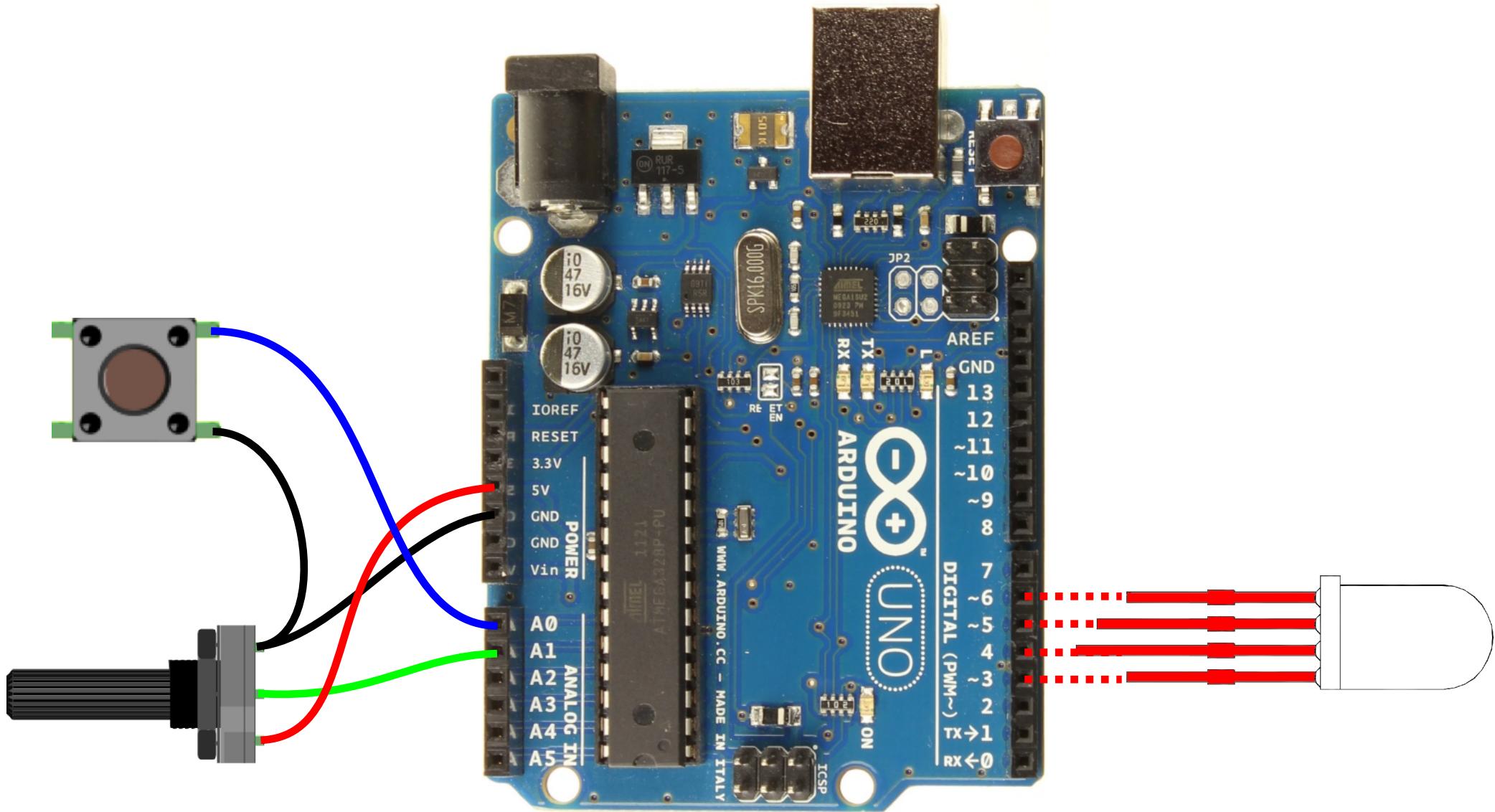


Cree MCE4CT (700mA)



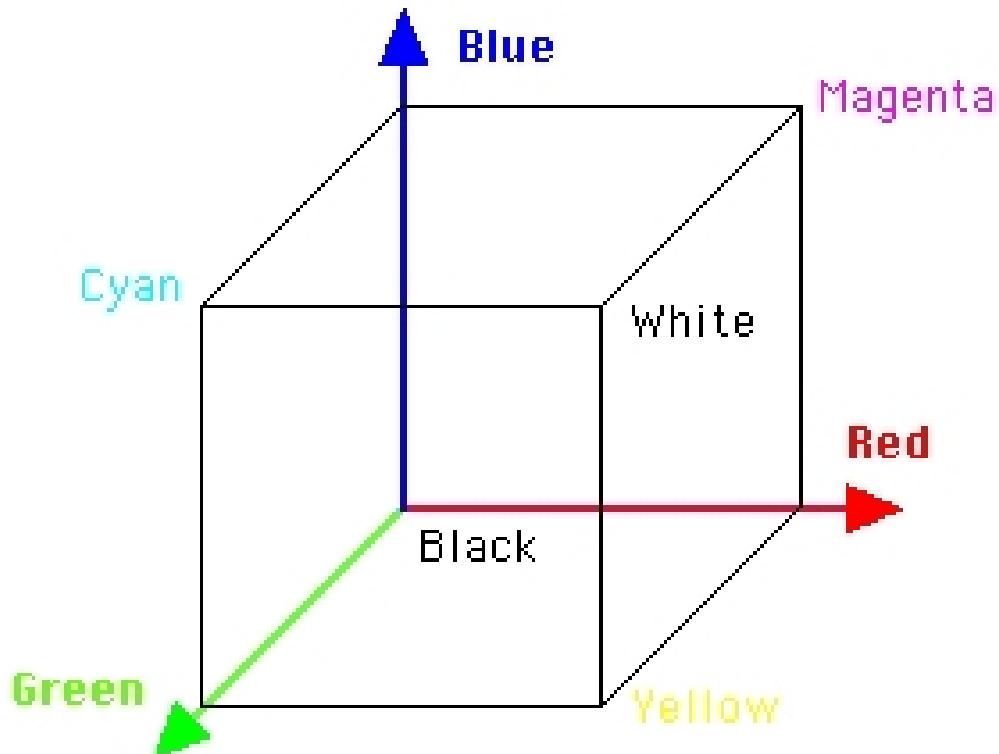
Additive Farbmischung

Aufbau



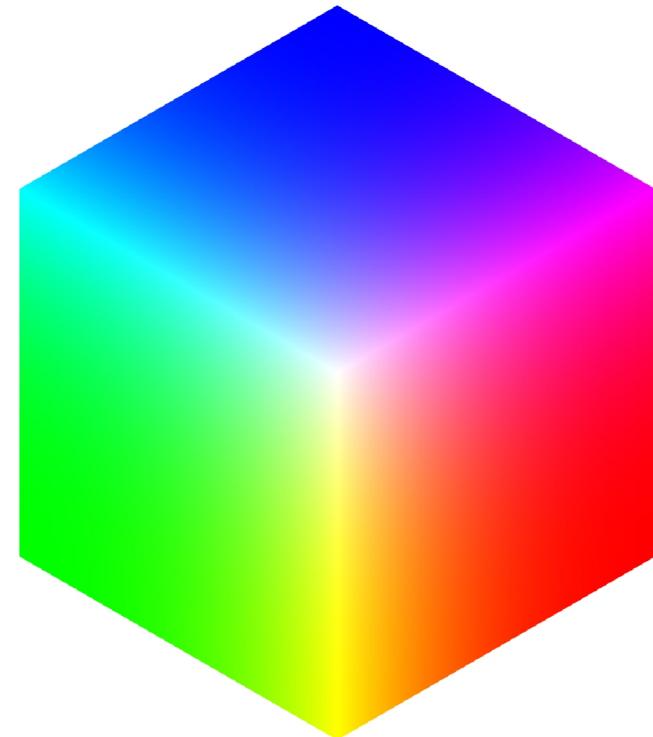
Farbraum

RGB Red - Green - Blue



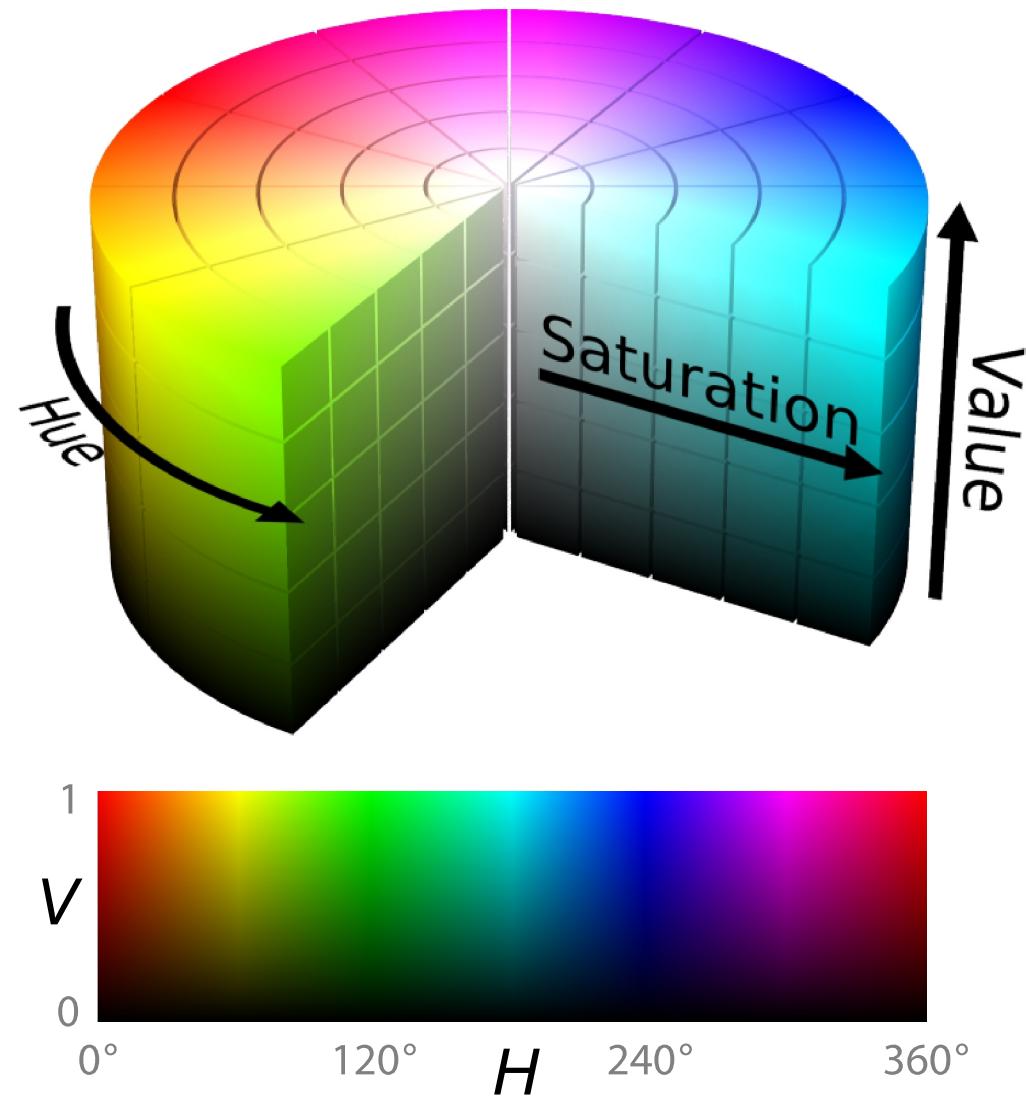
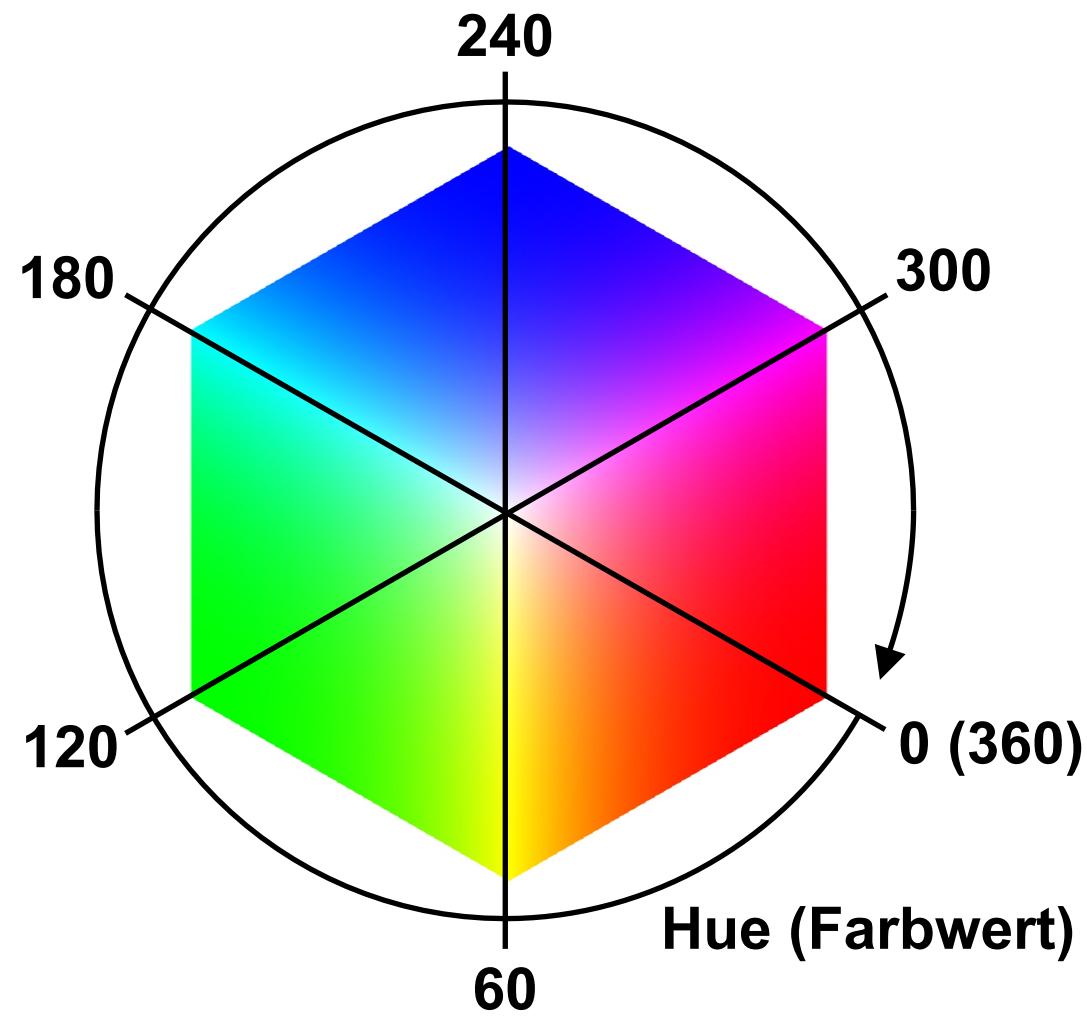
→ Bastelbogen: RGB-Würfel

Nachteil: Bei Änderung einer Komponente ändern sich Farbton **und** Helligkeit.



Farbraum

HSV (auch HSB)
Hue - Saturation - Value (Brightness)



Farbraum

TODO: RGB-Led über Hue steuern

Stromversorgung

Spannung (Volt)

Max. Stromstärke (Ampere)

~ Leistung ~ Anzahl LEDs

Kapazität (Ampere-Stunden)

TODO