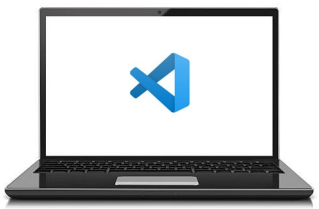
Your digital Toolbox (I) – The Basics

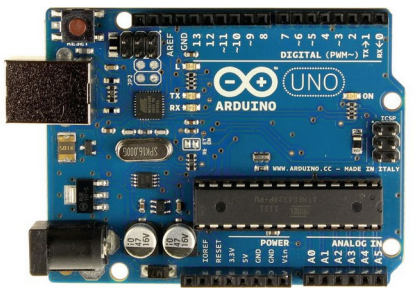
Physical Computing and Rapid Prototyping for Artists

New Talents Ruhr, 2024 · Day 01 · Johannes Bereiter-Payr

The digital workbench (IDE)



USB



1) Write Code (Editor)
2) Translate to machine code (Compiler)
3) Transfer to microcontroller (Programmer)
6) Optional: Show text from USB (Serial Interface)

4) Run the program
5) Optional: Output (debugging) information to USB

VS Code? PlatformIO? Arduino?

- VS Code = General Purpose IDE
  - An editor with benefits
  - Provides autocomplete, colored text, etc.
- PlatformIO = Plugin for programming microcontrollers
  - Creates machine code for specific microcontrollers
  - Provides templates for applications
  - Manage code and libraries (ie. other peoples code)
  - Communicates with the microcontroller via USB, for programming, debugging and serial communication
- Arduino = Framework which makes programming easier
  - Confusingly, also an IDE

But what is *programming*?

- Programming languages are readable for humans and machines
- Code = list of instructions which is processed *sequentially (one after another, top down, kind of)*
- *Compiling* translates human readable code to machine code (readable only by machines)
- One basic rule: write as little as possible yourself

C/C++ in 30 seconds

- A program is a list of commands
- Every command (line of text) must end with a semicolon ;
- Comments are human readable text that is ignored:

```
// In-line comment (after code in the same line)
/* Multi-line comment */
```

- Code-block: multiple commands between { … }

```
{
   command(some, stuff);
}
```

- Watch out for key-words!

Functions

- A function is a named list of commands

```
myFunction( can, be, customized ) {
   command1;
   command2;
}
```

- Functions can take parameters and return values
- How to call a function:

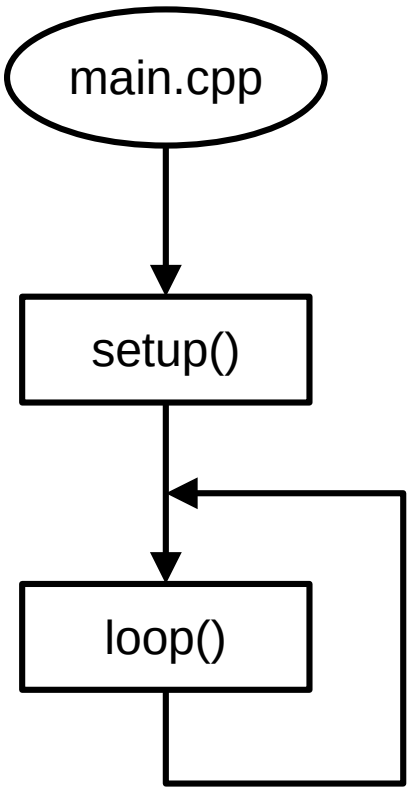
```
myFunction(„pass“, „parameters“, 123);
value = returnFunction();
```

Arduino program template (in 30 seconds)

- main.cpp contains the main program
- Must contain at least the following two functions

  `setup()`
  - Runs once after power cycle

  `loop()`
  - Main loop, called until power is turned off



Arduino: Most important functions

- `pinMode( pin, mode )`
  Set up a pin in input or output mode
- `digitalWrite( pin, value )`
  Turn an output pin on or off (HIGH/LOW = voltage, no voltage)
- `digitalRead( pin )`
  Read if voltage is present on input pin and output HIGH or LOW
- `delay( millis )`

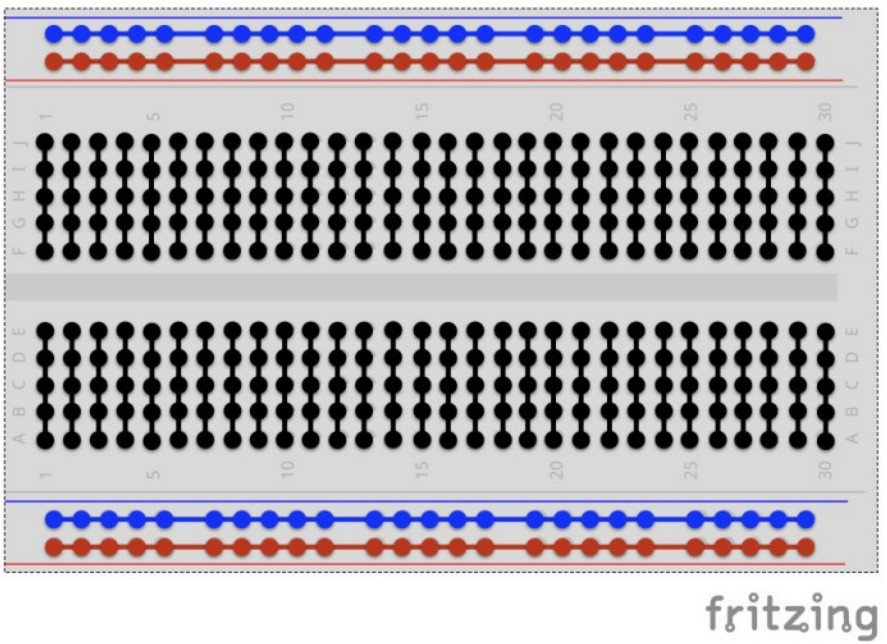
- Full reference: https://www.arduino.cc/reference/

Write beautiful code, make less mistakes

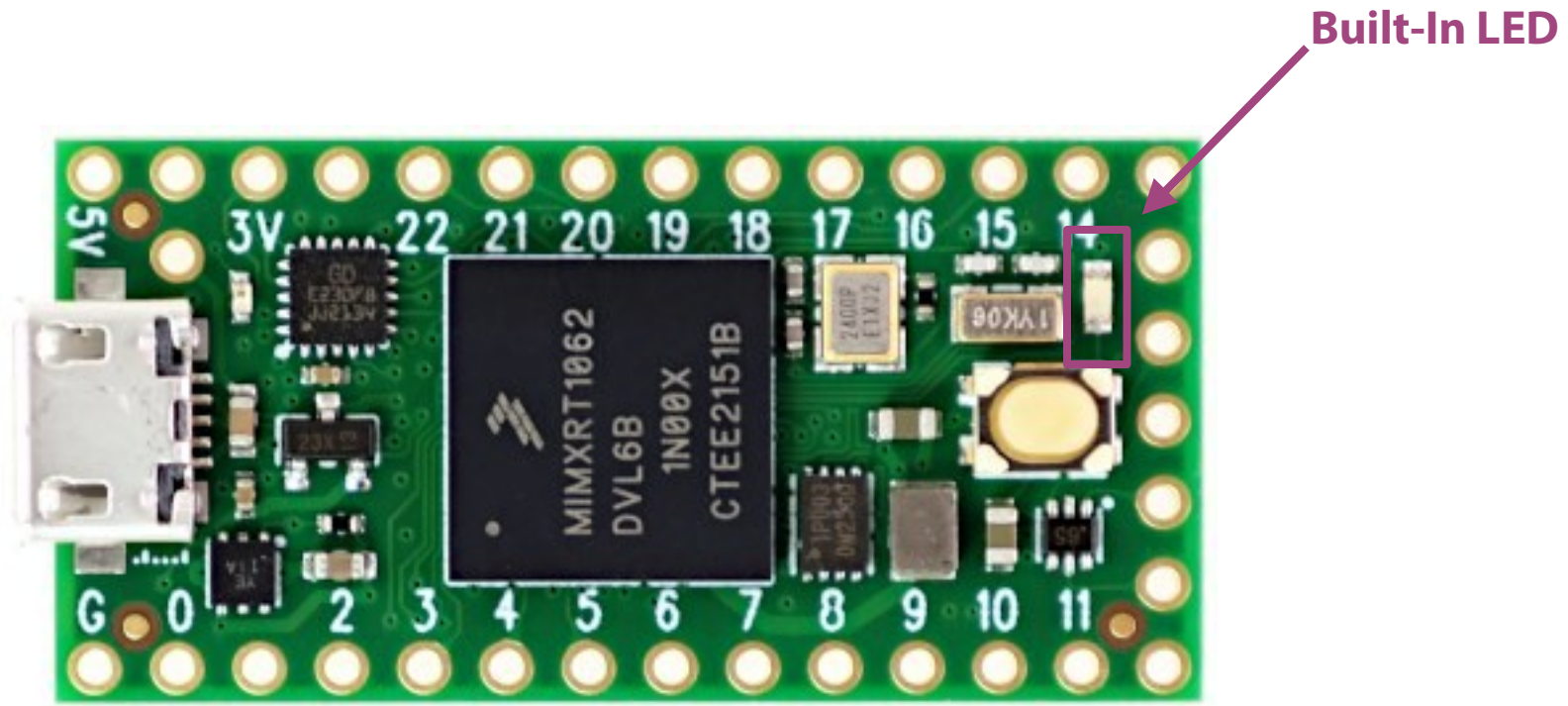
- Always begin function names in lower case
- Names should explain what the thing does
- String multiple words with camelCase or underline _
- Always indent (tab) in { code blocks }
- Only constants (unchanging values) in ALL_CAPS
- Use comments to explain what you're doing
- Do not use umlauts and spéciäl ¢hâract€r$!

Let’s get that party started!

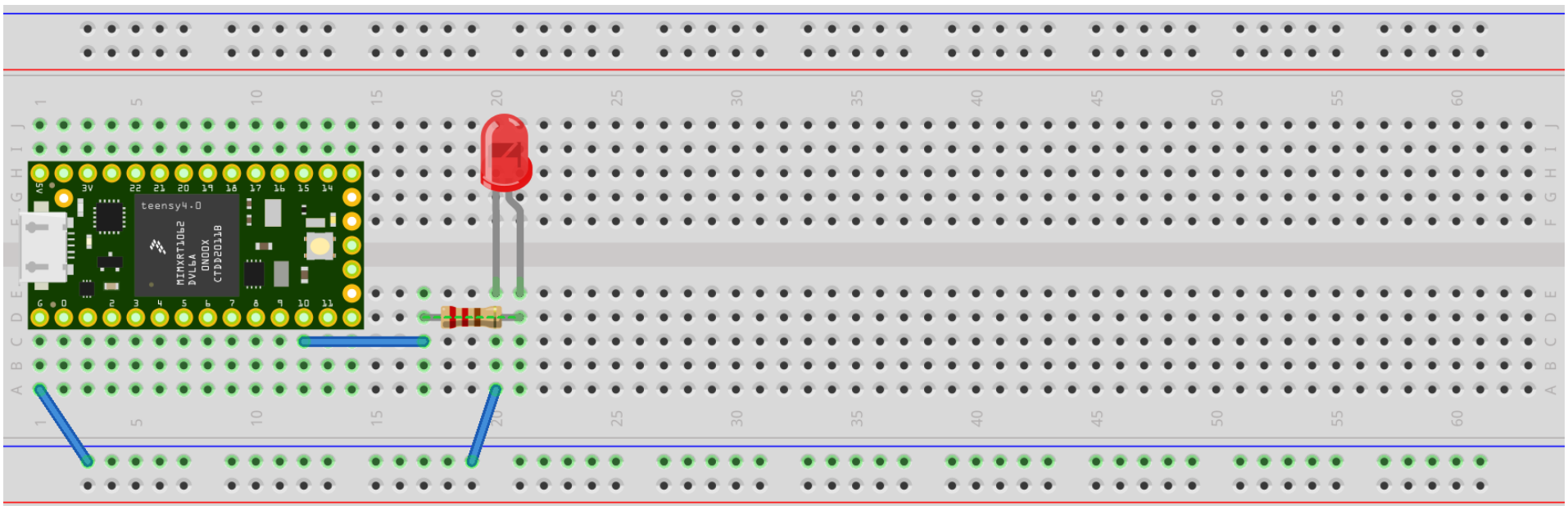
Breadboard Connector Layout



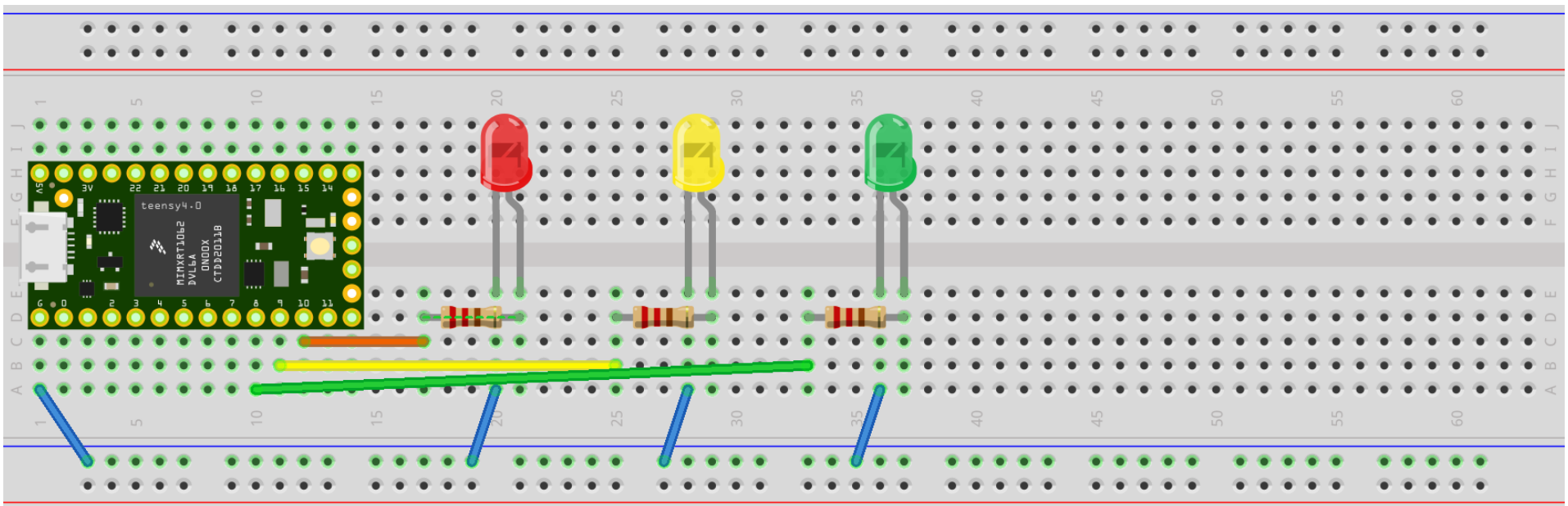
Hello ~~World~~ LED!



Hello another LED!



Hello more LEDs!



Take a deep breath...

We will be back after the break