

# GPIO and PWM

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## Input and output

The IO-pins on our development board are bidirectional and individually configurable. Pico SDK includes functions for setting pin direction and for reading or writing the pin state.

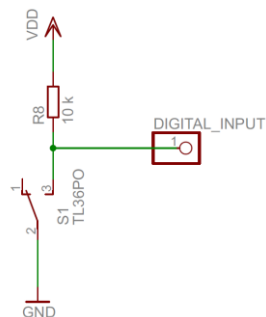
Study [https://www.raspberrypi.com/documentation/pico-sdk/hardware.html#hardware\\_gpio](https://www.raspberrypi.com/documentation/pico-sdk/hardware.html#hardware_gpio). Pay attention to configuring pin direction and pull-ups, and how to read the state of each pin.

Study [https://www.raspberrypi.com/documentation/pico-sdk/hardware.html#hardware\\_pwm](https://www.raspberrypi.com/documentation/pico-sdk/hardware.html#hardware_pwm)

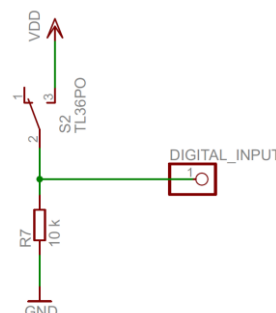
When simple (single pole) push button is connected to an input, a pull up or pull-down resistor is required to ensure that a pin always has a stable value. Pull up/pull down resistor will force the pin into a default state if the pin is left floating (unconnected).

A pin with a button and a pull up resistor has default value of one. When the button is pressed the pin goes low and reads zero.

A pin with a button and a pull-down resistor has default value of zero. When the button is pressed the pin goes high and reads one.



**Picture 1 Pull up resistor**



**Picture 2 Pull down resistor**

Our board has three buttons that are wired to GPIO pins 7, 8, and 9. The buttons are grounding buttons and need a pull up resistors for reading their state.

There are also three LEDs that are wired to GPIO pins 20, 21, and 22.

## Exercise 1 - Dimmer

Follow instructions in `clion_setup.pdf` to create CMake project.

Implement a program for switching LEDs on/off and dimming them. The program should work as follows:

- SW1, the middle button is the on/off button. When button is pressed the state of LEDs is toggled. Program must require the button to be released before the LEDs toggle again. Holding the button may not cause LEDs to toggle multiple times.
- SW0 and SW2 are used to control dimming when LEDs are in ON state. SW0 increases brightness and SW2 decreases brightness. Holding a button makes the brightness to increase/decrease smoothly. If LEDs are in OFF state the buttons have no effect.
- When LED state is toggled to ON the program must use same brightness of the LEDs they were at when they were switched off. If LEDs were dimmed to 0% then toggling them on will set 50% brightness.
- PWM frequency divider must be configured to output 1 MHz frequency and PWM frequency must be 1 kHz.